2 JANUARY 1959

METAL INDUSTRY

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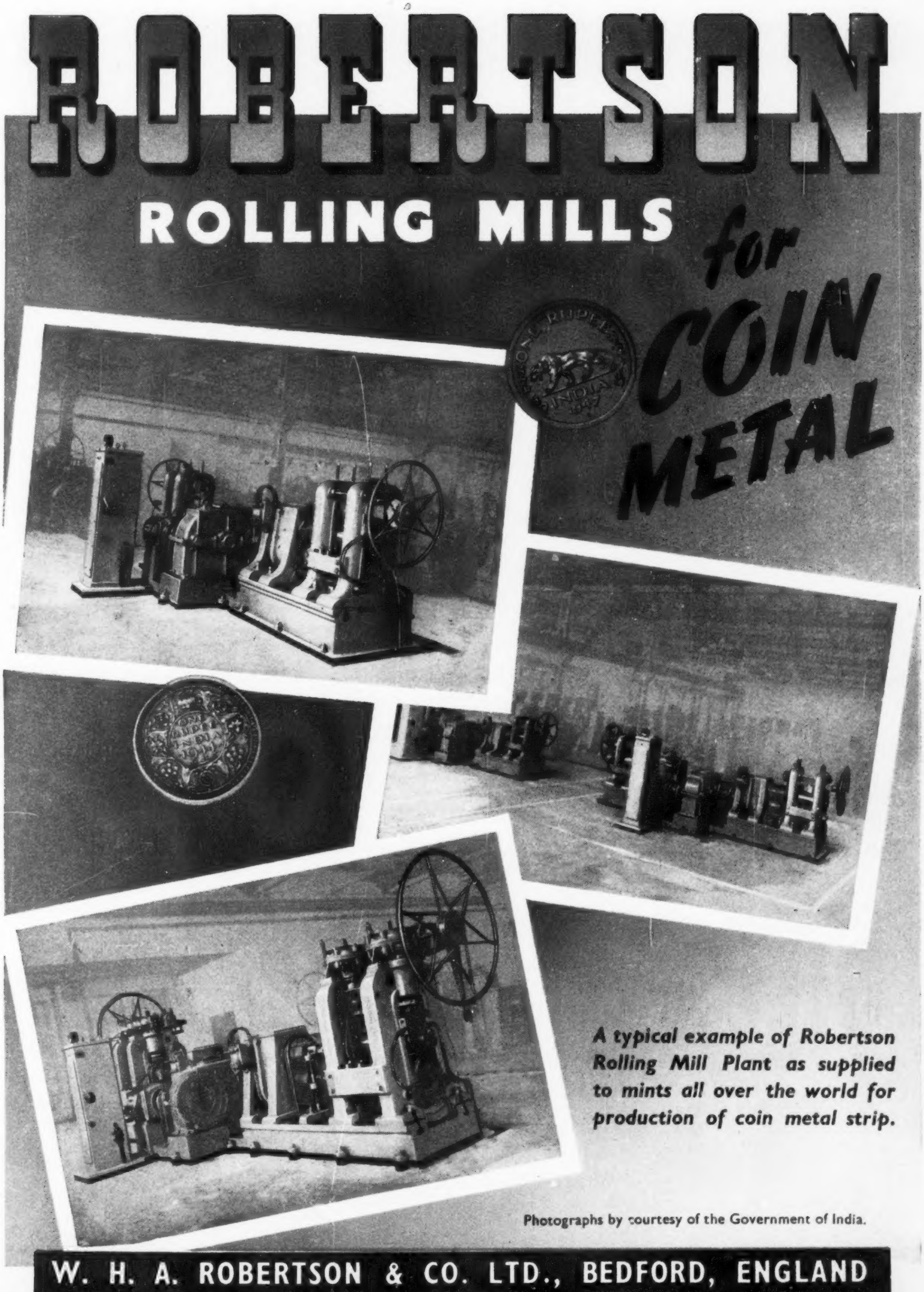
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METAL INDUSTRY

FOUNDED 1909

EDITOR: L. G. BERESFORD, B.Sc., F.I.M.

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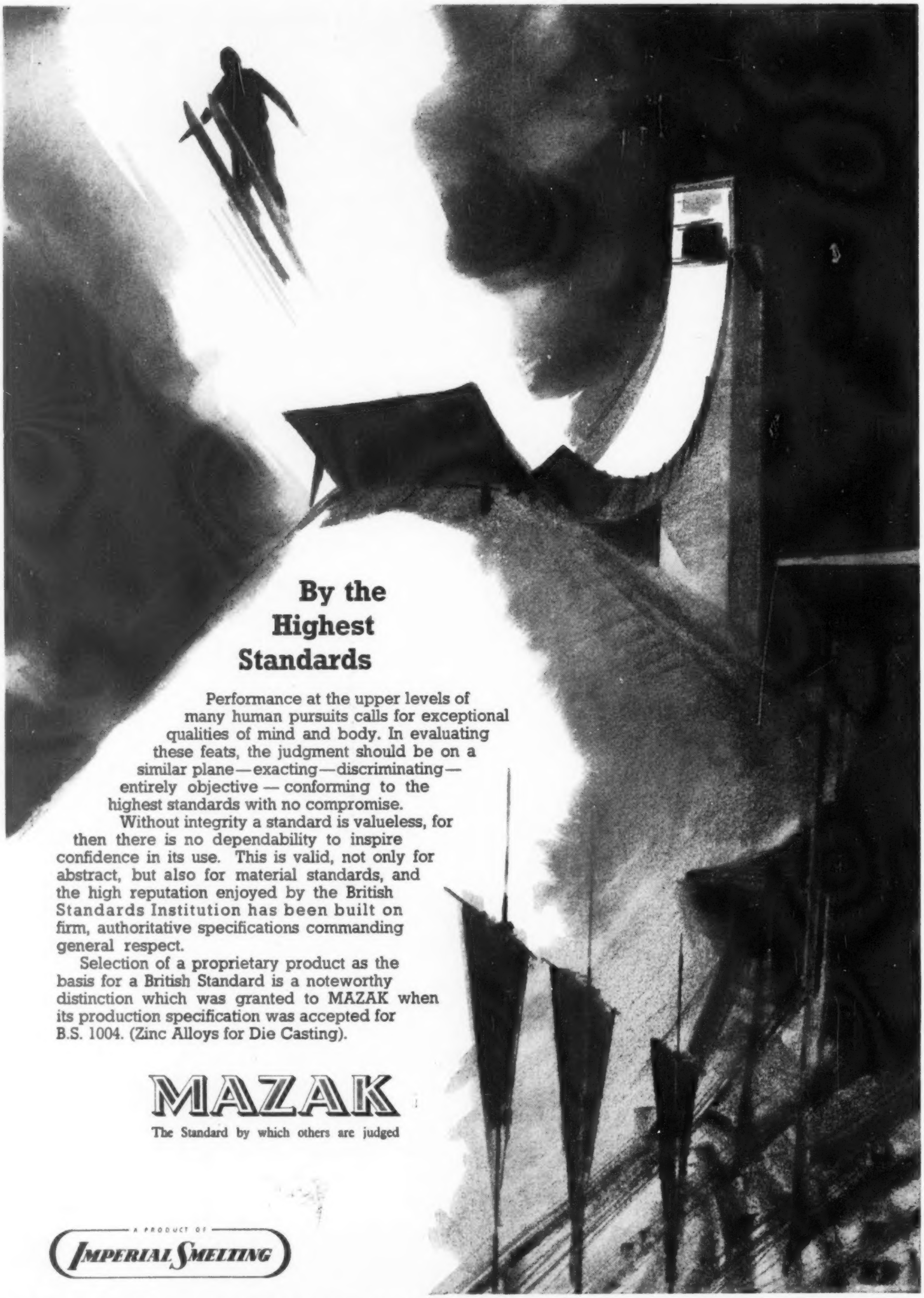
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METAL INDUSTRY

VOLUME 94 NUMBER 1 2 JANUARY 1959

A Five-Year Plan

READERS may remember that some years ago it was decided to adopt an experiment of financing the Department of Scientific and Industrial Research on a five-year basis. The experiment, which was designed to meet the needs of long-term planning of research, has proved successful, and the Government has now decided to repeat it for a further five years. Changing conditions may require from time to time a switch of resources from one type of expenditure to another, so there will be flexibility within the plan.

Expenditure on research by the Department for this second five-year plan will be nearly doubled. For the period 1959-1964, approximately £61 million will be made available to the Department, compared with £36 million for the first quinquennium which ends on March 31 next. Expansion will continue steadily throughout the period and for the year 1963-64 expenditure is planned to reach about £14 million. This figure does not include certain items, the largest of which is the British contribution to the European Organization for Nuclear Research, which will continue to be financed outside the five-year plan. The largest expansion is planned to take place in the field of scientific grants to the Universities. Postgraduate awards to students will be increased by about 10 per cent each year until in 1963-64, it is hoped, some 3,800 students will be receiving D.S.I.R. grants for research training. In the same year it is expected that the Department's support for special research in the research departments of Universities will be operating on a scale of about £1¼ million annually.

In support of additional research carried out in the Department's own laboratories, expansion of staff at the rate of about 6 per cent per annum—or approximately 30 per cent over the five years—is included in the plan. Grants to the Research Associations will also be increased to over £2 million per annum by the end of the period. At present there are some 49 organizations in the D.S.I.R. scheme. The Council for Scientific and Industrial Research will continue its policy of encouraging industry to bear an increasing proportion of the total cost. It may be expected, therefore, that the actual expansion of the R.A. movement will be proportionately greater than the increase in Government grant. It has also been decided to devote much more attention and more money to ensure that the results of scientific research are known and applied. It is also proposed that the Ministry of Works will increase its rate of expenditure on behalf of the D.S.I.R. so as to provide buildings and equipment for the increased staff of the Department's laboratories. The works programme includes the provision of a new laboratory at Crowthorne, to rehouse the Road Research Laboratory, which at the moment occupies two separate sites a few miles apart, one at Harmondsworth, Middlesex, and the other at Langley, Bucks. The new road research laboratory will include an experimental road system. As before, the financial provisions of the new five-year plan are, of course, subject to the necessary funds being voted annually by Parliament, and must be subject to a review in the event of a marked change in the economic situation or of major changes in cost. This information was given in the House of Commons before the recess by the Parliamentary Secretary to the Ministry of Works, speaking on behalf of the Lord President of the Council, who is Minister responsible for the D.S.I.R.

Out of the MELTING POT

Scant ONE still has to wait far too long between the infrequent appearances of examples of electroplating doing a little bit more than just electrodepositing metal. Examples of electroforming, electrobonding, and the like are still few and far between. Consequently, one's disappointment is all the greater when such an appearance, coming after innumerable appearances of, for example, more or less conventional plating baths with less and less conventional organic addition agents, brings out an example which, although certainly of interest, is described in a manner which does much less than justice to that interest. This is true in the case of a recent example of a variant of the electroplating process, the description of which fails to measure up to one's expectations. The electroplating process in question has for its object the production of a wear- and impact-resisting coating on metal parts such as steel rockers for valve gear. In the process, one or more dry lubricants are deposited "electrolytically by electrophoresis" on the metal part, together with a metal, preferably chromium, which forms an outer skin on the part. Dry lubricants suitable for this purpose include graphite and metal sulphides (e.g. zinc sulphide) possessing lubricating properties. Particularly good adhesion of the sulphide lubricant can be achieved by electrolytic deposition of the lubricant simultaneously with the metal forming the outer skin of the part. For this purpose, the metal sulphide is suspended in the plating solution, the suspension being agitated during deposition. A sufficient voltage for the deposition of the sulphide by electrophoresis will be used. And that is all. There are no details of plating conditions. One is left to wonder how, if at all, the voltage necessary for the deposition of the lubricant by electrophoresis can be used while, at the same time, maintaining the current density required for the successful plating of the chromium; or would "simultaneously" [illegible] over a process in which short periods of electrophor[illegible]: deposition and chromium plating followed one another in rapid succession? No mention is made of the thickness of the composite coatings deposited, nor of the even more important question of the proportion of the dry lubricant to metal in the coating. Can it be assumed that those "skilled in the art" do not require to be told all this? Unfortunately, such practical people are much more likely, in the absence of such information, to dismiss the process as impracticable.

Not To Worry NOT taking things for granted is supposed to be an essential characteristic of any attitude having any pretensions to being regarded as scientific. It is strange, therefore, that remarkably little of this characteristic is to be found in the current attitude towards the problem of what to do about the growing volume of scientific and technical literature. This attitude was only too clearly discernible at the recent International Conference on Scientific Information, held in Washington: the possibilities of national and international organizations and co-operation for the processing, recording and retrieval of information were considered, and the difficulties discovered in the process were used to emphasize the hopes now being pinned in increasing numbers to mechanization, from the sorting of punched cards to mechanical abstracting. All this is being taken for granted: the difficulties (and expense) of what might be called the pen and ink methods of coping with the growing flood of literature being what they are, mechanization is to be introduced to an increasing degree until some happy day when, with the last cogwheel (or should it be flip-flop circuit?) in position, the whole set-up will be ready to start operations. Is all this being taken for granted, because the neat way in which it can undoubtedly ultimately be made to work makes questioning appear unnecessary? Such questioning could, nevertheless, start by asking whether literature, which can successfully be dealt with only by mechanical means, is really what we want? And if the answer is yes, there will remain to point out that in that case it is the machines and not we that want it, and to consider what fare could be provided for us as an alternative to this machine fodder. While all this is being considered (if it is going to be considered), we can best stave off the neurosis likely to result from the repeated references to the amount of information we are missing under the present arrangements by the thought that, since we are not machines, the results, for us, of "keeping in touch and not missing anything" would prove disastrous. And having got this into perspective, why not settle down contentedly to consider how we can really make the best of what we do not miss?

Wider Use AMALGAMS do not come within the purview of the average metallurgist except on the occasions of the less painful visits to the dentist—occasions hardly propitious to much contemplation of the peculiar characteristics and of the potentialities of these materials. Besides, even on these occasions the metallurgist, instead of being given an opportunity of thinking about amalgams, may be induced to consider the various aspects of the replacement of substances metallic by ceramics. In view of all this, it seems desirable to draw attention in these more pleasant circumstances to the use of mercury as a constituent of compositions intended also for more pleasant purposes. These compositions are described as yielding "silver-like alloys which are valuable metallurgical compounds, and which are fully equivalent for industrial and technological purposes. Especial simulations of the precious metal silver, they can be used to replace the precious metal in dental work (*sorry!*), art articles and silverware industry." The following are the compositions (in per cent by weight) of alloys according to the invention: (1) 42·3 per cent tin, 21·1 per cent nickel, 18·6 per cent chromium, 18·0 per cent mercury; (2) 59·3 per cent tin, 13·1 per cent bismuth, 15·0 per cent cobalt, 12·6 per cent mercury; (3) 27·4 per cent tin, 32·0 per cent lead, 9·1 per cent cobalt, 16·1 per cent chromium, 15·4 per cent mercury.

Skimmer

INTRODUCTION OF CHLORIDES OF CARBON BY CARRIER GASES

Improving Aluminium-Magnesium Casting Alloys

By Dr. H. KESSLER

In this Paper the author discusses grain refining by means of the addition of the chlorides of carbon and briefly mentions the effect of the particle size of other grain refining additions. This article has been specially translated from a laboratory report of the Aluminiumwerke Nurnberg G.m.b.H. with whom the author is associated.

DURING the last few years experiments have been made in many laboratories in order to obtain an extremely fine-grained structure in aluminium casting alloys of different compositions. Reference may be made to numerous Papers dealing with aluminium-silicon casting alloys with silicon contents in excess of the eutectic composition commonly used in the manufacture of pistons.[1,2] Previously, methods for influencing the structure of other alloys, e.g. the aluminium-magnesium alloys, have also been reported.[3,4] Both methods for obtaining fine grain have in common the production of nuclei in the melt, whose crystal structure and lattice parameter are similar to those of the alloying constituents.[5] As is shown in some Papers,[2] the degree of grinding during preparation of the grain refining addition can have an important influence on the grain size of the structure of the alloy. These results, found previously only for aluminium-silicon casting alloys, gave rise to research on additions for the production of a fine-grained structure in aluminium-magnesium casting alloys. In some methods of grain refining for aluminium alloys,[1,3,4] the active crystal nuclei are produced by adding to the melt metallothermic mixtures, but it is by no means certain that these nuclei are extremely fine.

It was, therefore, hoped to produce nuclei in the melt by a continuous reaction between elements liberated by dissociation of added compounds and such contained in the melt as alloying constituents; the nucleation effect would then not cease too quickly with violent localized reactions. Since aluminium-magnesium casting alloys nowadays contain adequate percentages of titanium, boron and beryllium, it seemed expedient to search for a method which would allow the production of nuclei of titanium carbide and titanium di-boride, having a large effective surface, from the titanium and boron by a reaction with atomic carbon. It was advisable to make the addition of carbon to the melt with a gas containing carbon, in order to get the desired nucleation in the melt by splitting off carbon atoms and the formation of appropriate compounds. Suitable gases are, for example, town gas or methane, the former being usually available near the melting furnaces in casting plants.

Experiments carried out with these gases gave, as expected, rather good grain refining with aluminium-magnesium alloys containing titanium and boron. However, steam is produced at the surface of the melt by the combustion of the gases containing hydrogen. This leads to rapid hydrogen absorption by the melt because the steam is immediately dissociated.

In order to prevent the structure from becoming porous due to absorbed hydrogen whilst retaining the desired grain refining effect, a method allowing the separation of carbon from a gas without simultaneous hydrogen absorption by the melt has been investigated. A favourable solution of this problem has been found by using carbon tetrachloride and other chlorides of carbon (tetrachloroethylene, hexachloroethane, hexachlorobenzene). Carbon tetrachloride seems to be particularly suitable, because it can be introduced by preheated carrier gases as a non-combustible and non-explosive vapour, since it has a suitable boiling point of about 78°C.

The introduction of chlorides of carbon by carrier gases is performed by different methods suitable to the type of melting furnace used. In order to carry out the grain refining treatment in transfer ladles or holding furnaces, the carrier gas, preheated by an electric immersion heater, is bubbled in a fine stream through the chlorides of carbon. In this manner, the desired accumulation in the carrier gas of chlorides of carbon is obtained. Both are led through tubes to the bottom of the crucible, which contains the metal melt. These tubes are made of high-temperature-resistant graphite. In double-hearth furnaces the vessel, containing the chlorides of carbon, is attached to the furnace side, and the contents are in this way sufficiently preheated. A separate preheating of the carrier gases is not necessary. By using this method, a sufficient accumulation of the vapour of chlorides of carbon is obtained in the carrier gases.

It has been found that nitrogen is the most useful carrier gas, but in certain cases chlorine or inert gases are also possible. As much carbon tetrachloride vapour as possible is introduced into the metal melt by the carrier gas, with the CCl_4 added during the preheating, and is evenly distributed in the melt by a fine bubbling gas stream. Further experiments showed that the vapour dissociates in the melt, so that atomic carbon is produced in a particularly effective form, i.e. finely distributed and with a suitable surface. Reacting with titanium and boron, the carbon forms carbides and borides which bring about the desired refining effect in aluminium-magnesium alloys.[5] The simultaneously-formed chlorine gas has a cleansing effect on the melt, since the continuous stream and fine distribution of the chlorine in its nascent state produce an excellent degassing of the melt. Intensive mixing of the liquid metal is also effected by the carrier gas stream and the chlorine gas formed, which prevents the sedimentation of certain heavier nuclei.

More carbon will be introduced into the melt at a normal working temperature of about 740°C. than would be necessary for complete reaction with the available quantities of titanium and boron. With the usual percentages of alloy constituents, it has been found that 50 c.c. carbon tetrachloride are sufficient in 100 kg melt for the formation of the necessary nuclei, and that in the vapour phase this quantity can easily be introduced into the melt in 10 min. by 100 L. of carrier gas heated to about 80°C. An amount of 50 c.c. carbon tetrachloride is equivalent to about 4 gm. highly active carbon, with a large effective surface due to the fine distribution, and 15 L. chlorine gas, at N.T.P.

Experimentally, no accumulation of carbon tetrachloride vapour could be found over the melt, and only a small accumulation of chlorine gas. Most of the very active chlorine molecules react with magnesium to form magnesium chloride, and partly also with aluminium to form aluminium chloride. This can be seen by the formation of dross on the surface of the melt, which protects it against absorption of gas during agitation. Before pouring, thorough skimming of the melt is, therefore, necessary. Though the loss of magnesium is small, it should be compensated for by adding a corresponding quantity of magnesium in the case of a melt with a low magnesium content.

The efficiency of the method for grain refining[6] is influenced by the carrier gases used. It is worth mentioning that the carrier gases must be completely dry, because otherwise dissociation of steam will cause absorption of hydrogen.

Chlorine, as a carrier gas, does not cause the degree of grain refining observed with nitrogen. However, in order to obtain a completely clean and

a

b

c

Above left: Fig. 1—Fracture structure of an aluminium-magnesium casting alloy containing titanium, boron and beryllium. (a) Original condition, unrefined; (b) Partial grain refining by chilling; (c) Uniformly fine-grained structure after treatment with the described method: introduction of CCl_4 vapour with nitrogen as carrier gas

Above right: Fig. 3—Macrostructure of the alloy of Fig. 1 compared with the structures indicated at a, b and c. (Scale 1·3 : 1)

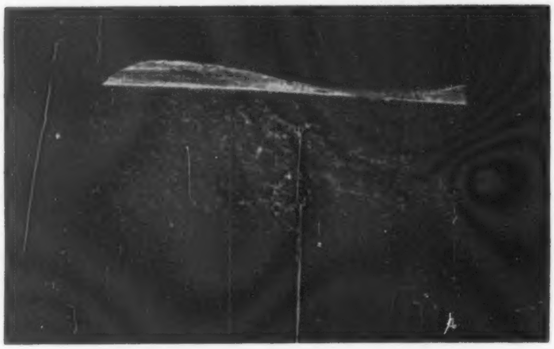

Fig. 2—Fracture structure corresponding to Fig. 1c. A small coarsening of the structure due to using chlorine instead of nitrogen as carrier gas

degassed melt, it has been found convenient to use a short-time chlorine gas treatment near the end of the grain refining process. Chlorine gas treatment for 5 min. or less was particularly effective in addition to the grain refining treatment, limited to a period of 10 min.

The very favourable grain refining effect of the method described above is illustrated in Figs. 1-5. Fig. 1(a) shows the fracture structure of an alloy Hy 511 which has not been subjected to grain refining. Fig. 1(b) shows the medium fine grain of the same alloy after partial grain refinement was enforced by the generally known chilling effects in permanent mould casting. Finally, Fig. 1(c) shows the extreme grain refining obtained by the careful application of the described method. A comparison of Fig. 2 with Fig. 1(c) clearly shows the coarsening of the structure if chlorine is used instead of nitrogen as the carrier gas.

It is a well-known fact that aluminium alloys containing magnesium often have an irregular appearance of fracture because the structure contains mottled areas, as seen in Fig. 1(a). It appears that by the continuous liberation of chlorine gas in the melt a

TABLE I—PHYSICAL PROPERTIES OF Al-Mg 511

Test Temperature °C	0·2 per cent Proof Stress kg/mm²	Ultimate Tensile Strength kg/mm²			Elongation on 5·65 $\sqrt{A}$ per cent			Hardness H_B5/250/30 kg/mm²
		Before grain refining	After grain refining	Increase per cent	Before grain refining	After grain refining	Change per cent	
20	12·1	17	19·8	16·5	2·2	3·7	+68	70—80
100		16·6	19·7	18·5	2·3	3·8	+65	
200		15·1	19·9	32	3·3	4·0	+21	
300		11	19·6	78	10·0	4·2	−58	
350		8·1	19·0	135	19·6	4·4	−77·5	

cleansing and homogenizing of the melt is obtained, so that the fracture structure of the treated alloy is much cleaner and more homogeneous, although a coarsening of the structure and porosity are, of course, inevitable in that part of the molten metal which solidifies last (Fig. 1(c)).

In Fig. 3, the macrostructures of the specimens corresponding to Fig. 1(a), (b) and (c) are shown.[7] It is possible to recognize the improvement in structure in the specimen in Fig. 4 compared with the otherwise treated specimens (a) and (b).

The advantage of the grain refining method can also be demonstrated by considering the microstructure. The original quite good microstructure of Fig. 4, compared with that of Fig. 5, shows the effect of grain refining.

Before introducing the new method of grain refining in the casting divisions, not only its influence on the structure of the aluminium-magnesium casting alloys was investigated, but also possible changes of the physical and mechanical properties of these alloys.

For this purpose, a great number of tests were carried out to compare the untreated alloys with those treated by the new method in respect of the values for proof stress, tensile strength, elongation, hardness, rotating-beam fatigue strength, and notched-bar impact strength. It may be said at once that these tests proved, first, that an improvement of the aluminium-magnesium casting alloys was obtained by this method of grain refining compared with the untreated alloys of the same composition, and, secondly, that there was almost no difference in the values for tensile strength and elongation between separately cast test bars and those cut from any portion of the casting. Finally, some values of mechanical properties which are of particular interest practically were measured at higher temperatures.

Mechanical Properties

The tests for determining different physical and mechanical properties were mostly carried out on alloys whose composition corresponds to the standard specification for Al-Mg 511 casting alloy, 4·5-5·5 per cent magnesium, 0·1-0·6 per cent manganese, 0·6-1·5 per cent silicon, 0·6 per cent iron max., 0·6 per cent copper max., 0·2 per cent zinc max., 0·2 per cent titanium max., approximately 0·005 per cent boron, 0·001 per cent beryllium max., remainder aluminium.

Further tests for the confirmation of the observed improvement were made on alloys containing mainly aluminium and magnesium. For instance, numerous tests were carried out on aluminium-silicon-magnesium casting alloy (Nüral 25) with the same good results. However, all the values given in this Paper refer to the Al-Mg 511 type of alloy.

The measured values for the unrefined and refined alloys corresponding to the appropriate testing temperatures are to be found in Table I. The percentage increases in ultimate tensile strength values, and the difference in elongation between unrefined and refined alloys are also stated. The evaluation of numerous comparison tests showed that, besides a notable improvement of tensile strength at 20°C., a considerable increase of the tensile strength is found at temperatures up to 350°C., and it can be stated that for alloys refined by the described method the tensile strength remains nearly constant in the range 20°-300°C. The constancy of the values for elongation in the same temperature range also show a clear improvement.

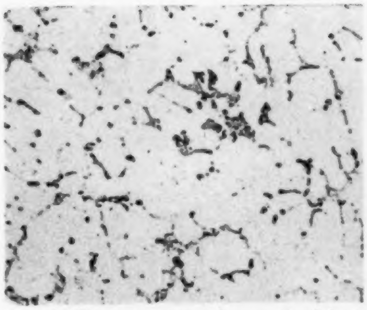

Fig. 4—Microstructure of an aluminium-magnesium casting alloy, unrefined. (×100)

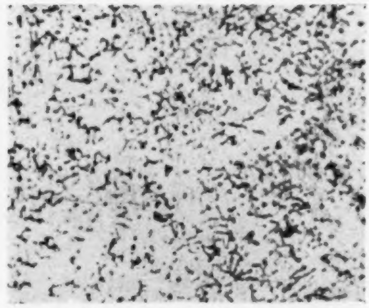

Fig. 5—Microstructure of an aluminium-magnesium casting alloy, refined by using the described method. (×100)

For castings required to withstand high thermal and mechanical alternating stresses, it is naturally very interesting to determine the notched-bar impact strength and the rotating-beam fatigue strength of the refined alloys, because it is sometimes found that, in spite of an appreciable improvement in tensile strength and elongation, the use of an alloy for castings which are required to withstand such stresses is impaired by brittleness or sensitivity to grain boundary cracking.

In fact, the notched-bar impact strength, particularly at higher temperatures, and the rotating-beam fatigue strength were clearly improved by refining of the alloy. The improvement was 8 per cent for the notched-bar impact strength, the value obtained being 48 cm kg/cm^2 at 300°C., and about 12-15 per cent, at the value of 10-11 kg/mm^2, for the rotating-beam fatigue strength at 20°C.

Summary

The treatment of aluminium alloy melts containing magnesium with chlorides of carbon, preferably carbon tetrachloride, introduced by carrier gases, produced grain refining, which can be seen in the fracture structure as well as in the macro- and microstructure. A remarkable improvement of the physical and mechanical properties of the alloys was also found.

A further result is that, owing to the described grain refining, the ultimate tensile strength values remain constant in the range of 20°-300°C. The advantage obtained at 20°C. is increased at higher temperatures. The introduction of gases dissociating in the melt effects a cleansing of the melt, which can be seen in the homogenizing of the structure and the complete absence of trapped gases. These advantages are of particular practical importance, because sound castings, largely free of pores and cavities, can be made by this method.

The results of the tests showed further that an observation described in an earlier Paper[2] is also important for the aluminium-magnesium casting alloys; the size of the nuclei inducing the grain refining has a considerable influence on the refining effect. The knowledge gained during the development of the earlier method suggests the treatment of other alloys with nucleants, with an expectation of a grain refining effect on the solid solutions found in these alloys, by reason of the similarity of crystal structure and lattice parameter.

The described method of improving the physical and mechanical properties characteristic of the alloys, especially at higher temperatures, by grain refining should stimulate further development of such methods. This might be the only way to secure new applications for aluminium and its alloys in parts subjected to high thermal and mechanical stresses, since the possibility of improving the alloys by additions seems to be in the main exhausted.

This method of grain refining, which has proved particularly successful in aluminium-magnesium casting alloys, has failed when applied to aluminium alloys of other compositions, e.g. hypo-eutectic or eutectic aluminium-silicon alloys.

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Research Progress

Analysis of Gases in Metals

BY RECORDER

MOST commercial metals contain, as accidental impurities, small amounts of oxygen, nitrogen and/or hydrogen. It has become increasingly apparent that these contaminants can affect substantially the properties of a material: for instance, the embrittling action of hydrogen in steel and titanium is of practical significance. More attention is, therefore, being paid to the elimination of gaseous impurities, as in vacuum melting, for example, and, indeed, such control is essential in the handling of some of the more recently developed alloys, e.g. of titanium, zirconium, etc.

This situation has created the need for methods by which these impurity contents can be determined. The influence of the gaseous elements on properties is often so potent that amounts more conveniently stated in parts per million (p.p.m.) than percentages must be accurately measured. The low levels involved then, give rise to one difficulty that is augmented by others peculiar to the elements concerned: thus the spectroscope as normally used is valueless for the determination of the oxygen content of a metal, as the air surrounding the spark will give emissions masking the oxygen spectrum from the sample. The high affinity between some of the newer metals particularly and the gaseous impurity may also pose problems, and it may be found necessary to attack the metal with extremely corrosive reagents in order to separate the element to be assessed—an alternative approach here is to liquefy the sample, but fresh difficulties in containing the reactive liquid metal without undesirable contamination must then be faced.

Hydrogen in Titanium

Two recent publications give an interesting picture of the present position with regard to the analysis of metals for hydrogen and oxygen. In the first,[1] the author, T. D. McKinley, of E. I. du Pont de Nemours, reviews American equipment and methods for the determination of hydrogen in titanium. Since hydrogen can be removed from titanium and its alloys by reducing the partial pressure of hydrogen at the free surfaces of the heated metal, three principal methods for determining the quantity present are available. In the first, the sample is heated *in vacuo* and the hydrogen evolved is collected and measured. To reduce the time required for each analysis, and because increasing the temperature of treatment lowers the residual hydrogen left in the sample, the extraction has to be carried out at 900°-1,000°C. for moderate hydrogen content, but at higher temperatures, say 1,400°C., for low initial levels. In the latter case the apparatus is somewhat complex, since induction heating must normally be employed and the sample held or be adjacent to a good electrical conductor. Graphite crucibles are frequently used, with powdered graphite as an insulant between crucible and outer containing tube. This arrangement takes rather a long time to degas, however, a fault that can be avoided by substituting for the graphite a molybdenum crucible or boat, the inner surface of which may be coated with thoria to prevent welding of the samples to the molybdenum.

In the above method, the hydrogen evolved is measured directly, so that a flexible system attached to the extraction tube is needed to cater for varying volumes of gas. The size of specimen that can be handled is also limited by the difficulty of collecting large quantities of gas at low pressure, as well as by the time required for complete extraction.

The maximum permissible specimen size can be increased and parts of the apparatus simplified by allowing the evolving hydrogen to remain in contact with the heated specimen in a relatively confined space. Under these conditions an equilibrium is set up in which the pressure generated by the evolved gas is determined by the original hydrogen content of the sample, the metal composition, and the temperature. Once these factors have been correlated, very rapid determinations of hydrogen content can be made and, since reasonably high equilibrium pressures are obtained at temperatures of 1,000°C. or less, the heating and container problems are simplified. Unfortunately, the equilibria are governed *inter alia* by alloying content, thus commercially pure titanium at 1,000°C. gives an equilibrium pressure of 0·001 mm. Hg when containing 9·2 p.p.m. hydrogen: the same pressure is given by the titanium-6 per cent aluminium-4 per cent vanadium alloy when containing 5·4 p.p.m. Each alloy must, therefore, be investigated and an equilibrium pressure:hydrogen content curve established before the method can be utilized for that alloy.

The third principal method described by McKinley is vacuum fusion which, he suggests, is essentially an extension of the full extraction procedure. Here, oxygen (in the form of CO) and nitrogen will also be present in the evolved gases, and separations, usually by fractional freezings, are necessary. McKinley states that hydrogen is determined by difference, though it would seem more common for the gas to be converted to water vapour and the amount obtained directly. Be that as it may, the method requires a complex apparatus and the analysis takes a considerable time. For the determination of hydrogen in titanium, it is unlikely to be preferred to either of the previous methods. Vacuum fusion does afford one of the few ways in which the oxygen content of titanium and other metals can be obtained, however, and the method, therefore, figures prominently in two of the Papers presented at an A.S.T.M. Symposium on the determination of gases in metals.[2]

The two sets of apparatus described show few unusual features, both employing graphite crucibles insulated with graphite powder. The long outgassing times needed when the latter material is used contribute to the overall length of time taken for analysis and it is surprising that effective radiation shields have not been developed to eliminate the necessity of using graphite powder.

Oxygen Analyses

A. L. Beach and W. G. Guldner, of the Bell Telephone Laboratories, describe experiments on the analysis of oxygen in molybdenum, silicon, tantalum, and germanium. Most of these materials must be "fluxed" if rapid and complete evolution of oxygen (as CO) is to be obtained. An iron bath has been widely used for this purpose but suffers from the disadvantage that when a number of successive analyses are required the melt becomes pasty, due to carbon absorption. The Bell workers investigated the effectiveness of various baths—nickel at 1,650°C., iron at 1,650°C., iron-5 per cent tin at 1,650°C., nickel at 1,850°C., nickel-tin at 1,850°C., and platinum-iron at 1,900°C.—for use in measuring the oxygen content of molybdenum. Erratic results were obtained with iron, platinum-iron and nickel baths, the latter metal giving more reproducible results when operated at 1,850°C., however, than at 1,650°C. The iron-5 per cent tin melt appeared to be the best, the oxygen contents so determined being the highest and most reproducible.

The analysis of silicon presented different problems. The silicon content of the bath must be kept down otherwise rapid penetration of the graphite crucible occurs; specimen

(*Continued on page* 11)

Pressure Die-Casting Review

Design of Die-Castings

IX—Converting Sand-Cast Parts to Die-Casting

By H. K. BARTON

THERE can hardly be any manufacturing process the products of which have not, at some time or other, been replaced by die-castings. Capstan products, stampings, machined extrusions and even plastics mouldings have, in various applications, given place to die-cast components; for the most part, these very disparate conversions have proved quite successful. It is, nevertheless, often fairly easy to detect—or at any rate to guess—that a particular die-casting was previously made as, say, a stamping or from a cross-section of extruded aluminium, because features demanded by the original process still remain apparent in the component after re-design.

In fact, the adaptability of the die-casting process is such that many conversions are made virtually with no change of form in the component; the die-casting reproduces exactly the contours and surface detail of the piece as originally manufactured. This adaptability of the process is, of course, highly valuable when every detail of a component is determined with reference to its functional operation, and quite frequently makes possible, for example, the use of a single die-casting in the place of a sub-assembly consisting of several parts produced by different processes. In practice, nevertheless, it is seldom indeed that every detail of a part—still less of a sub-assembly,—is functionally determined, and as a general rule it is worth looking hard at every projected conversion to see if there is any possibility of either simplifying its production or increasing its utility in service.

A very large proportion of conversions to die-casting is, of course, represented by changes from other foundry processes and, in particular, from sand-casting. The mere increase in the quantities of a component required often suggests a change to die-casting, especially in the case of pieces requiring an appreciable amount of machining. Even when this latter consideration does not apply, however, conversion may be thought worth while; of recent years there has been a trend towards "sympathetic" conversion of small parts such as thumbscrews, knobs, hand-wheels and the like. These occur when some large component, generally a housing for domestic or garden equipment, is converted from sandcasting to either gravity—or pressure—die-casting. This so improves the general appearance that a parallel upgrading of the associated small parts becomes essential.

Despite the fact that all the foundry processes have a good many requirements in common — or, perhaps, because of this—it is probably in the conversion of sandcastings to die-castings that most opportunities for re-design are missed. It is certainly in this field that the most uneconomic demands upon die-casting are made. On the one hand, it is very common to come across components that unnecessarily reproduce sandcasting features such as heavy sections and coarsely scalloped profiles (Fig. 1, top), whereas the same parts might so easily have been refined in section and contour, and "grip" been provided in a more attractive manner, as in the lower sketch.

As against this, users of sand-castings that are machined almost all over to close limits, and carry a variety of milled slots and holes bored to meticulously exact pitches, often demand that all the features that have hitherto been produced by machining shall be already incorporated in the die-casting as it comes from the die. Although such exacting requirements as these can, in a surprising number of cases, be achieved—even economically achieved—one does not have to look far for instances where the pursuit of perfection is proving unnecessarily costly. Often, of course, this is not immediately obvious; the cost of machining may well have been so high that an elaborate die-casting produced slowly to a high degree of precision still shows a saving. It is seldom evident, unfortunately, that a simpler die operating at a faster rate, coupled with the adoption of one or two simple machining operations, could have resulted in an even cheaper yet equally effective die-casting.

Very many components converted from sand- to die-casting are, even when otherwise well designed, of unnecessarily thick section. This is very noticeable when comparing such pieces with die-castings of the same general form that have replaced sheet metal parts. It seems likely that this reluctance to thin down the wall of a casting is often based more on psychological factors than upon the functional requirements of the component. Even though it is known and accepted that the thin-walled die-casting, with its dense outer skin and freedom from pipes and inclusions, is much stronger, weight-for-weight, than an equivalent sand-casting, it is still not easy to bring oneself to implement what, on the drawing board, seems a very drastic section reduction. Whatever the actuality, the thicker section looks stronger in the drawing and, too often, this purely visual effect is allowed to override the facts of the matter.

This particular prejudice does not operate when converting pressings and the like, since in this case the modifications normally comprise the provision of ribs and other elements that give a visual effect on the drawing board, as well as an actual one in the component, of increased strength. So much is this the case that a designer not well conversant with the die-casting process might seriously be advised to consider redesigning his sand-cast component as a deep drawing or pressing in sheet steel—at least so far as the general form and main contour changes are concerned—and thereafter to use this sheet-metal design rather than the original casting as a basis for the die-cast component.

This suggestion is less perverse than it may at first sight appear, for whereas it is always possible to increase the wall thickness of a die-casting if it proves too thin, it is impracticable, short of major die changes, to reduce the thickness of a casting that is unnecessarily heavy. It is not often that important dimensions of a component, associated with datum points on different faces of a component, are themselves required to be in an exact relationship; that is, the majority of dimensions are likely to be as either *A* or *B* in Fig. 2, with very few carried across the section after the manner of the dimensions *C* or *D*.

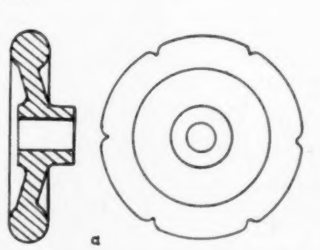
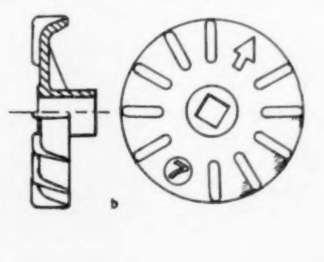


Fig. 1—A heavy section cast-iron hand wheel (top) is here compared with a thin-walled die-casting providing improved grip as well as means of identification, orientation and positive location upon the spindle



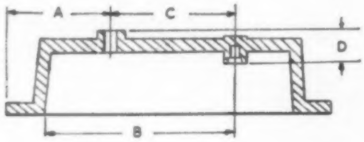
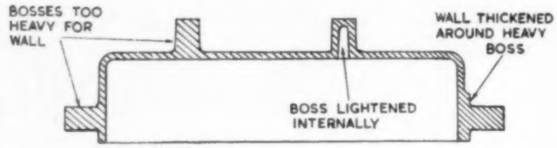


Fig. 2—Dimensions like A and B, taken between points in one half of the die only, are easier to hold to close limits than "mixed" dimensions such as C or D

Fig. 3—Heavy bosses rising from thin webs (left) should either be lightened or given an appropriately thickened adjoining wall section



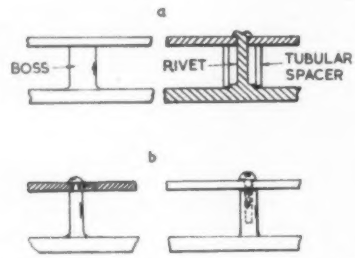


Fig. 4—Methods of attachment for sub-assemblies

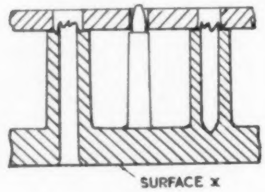


Fig. 5—The holes in the top element are large enough to accept flash around the cored holes in the quills. Registration is separately achieved either by dowel elements, as shown, or by recessing the underside of the top plate to take the ends of the quills

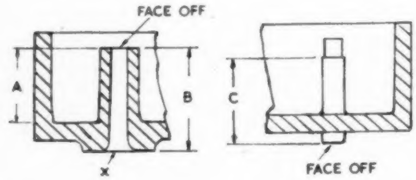


Fig. 6—If dimension B is very critical, the top face of the slender quill may be faced off. In the case of dimension C (right) the external boss and not the end of the shouldered stud should be machined, or not enough metal may be left for peening over

Because of this, it is often possible during the early stages of design to consider the component as consisting of two separate shells, one corresponding to each portion of the die cavity. Each shell may be dimensioned separately except with regard to dimensions like *D*, so that the wall thickness can at this stage be looked upon as a variable. It is better for the designer to hold the wall initially to a minimum and to increase it should the die-caster think this necessary, rather than attempt to determine the optimum value.

The required wall thickness for a given component is primarily determined by the superficial area over which the metal must spread, but several factors work to modify the simple relations (Table I) connecting optimum section thickness and area. In particular, any details of design that tend to slow down the operating speed make it more difficult to produce really satisfactory castings of very thin section; if, therefore, two or three heavy core-slides will be needed in the die to produce the required contours, it is likely to prove necessary for the wall to be thicker than for a simply-contoured part capable of being produced at, say, 300 instead of 180 pieces/hr.

The optimum wall thickness is also affected by the presence or absence of local concentrations of metal, particularly uncored bosses of some height, as depicted in Fig. 3. The thinner the section from which such features rise, the more difficult it is to maintain soundness within them and avoid surface defects in the immediately adjoining areas of the casting. Here, of course, the best remedy is to eliminate, if at all possible, the heavy sections, but if this is impracticable a heavier wall is called for. The section increase may be localized, as on the right of the figure.

In a surprisingly large proportion of applications, however, some at least of the heavy sections can be eliminated or reduced; this is most frequently so in the case of bosses that, in the sand-casting, were faced off for the mounting of some subsidiary component. The purpose of these is merely to hold the latter in a designated position relative to the casting or to some other sub-assembly, and this can often be achieved by other means. One of the simplest (and one that does not usually necessitate any change in the part being mounted) is the replacement of the faced-off bosses by integral rivets, as shown in Fig. 4.

As there seen, the required set-off from the inner face of the casting is obtained by dropping tubular spacers over the rivets before mounting the plate; the rivets are thereafter staked or spun, as indicated on the right. This method has the advantage of providing variable height or mounting with little difficulty; the spacers only need be changed to obtain a small difference, but it is always possible to modify the rivet height in order to avoid an inordinate length of protrusion should the spacer length be shortened by, say, a quarter of an inch.

An alternative method that is applicable when the sub-assembly is subjected to little mechanical stress allows the omission of the spacers, the integral rivets being cast with a shoulder 0·010 in. or 0·015 in. wide (Fig. 4b, left). This locates the flange of the subassembly, and the projecting portion of the rivet is spread to retain it. In applications of this sort, the fixing holes in the flange and the mating ends of the rivets will virtually always be of too small diameter for effective spinning over. Staking by impact should, however, be avoided, since it may result in half the rivet tip breaking away. The most satisfactory method is to use a conical punch in a relatively slow-moving press of fixed stroke. A hand-operated toggle press is ideal, and if the die-casting is mounted on a slideable location plate the forward and backward strokes of the toggle can be caught.

Either of these methods eliminates localized heavy sections, though each has the disability associated with all applications of integral rivets—that a definite rise in the scrap rate, due to faulty rivets either detected at inspection or becoming apparent during assembly, is almost inevitable. The larger and more complex the die-casting, the greater proportionately is

TABLE I—PREFERRED WALL THICKNESS

Cube root of external surface area × given factor, within indicated maxima and minima.

Alloy Group	Factor	Maximum Thickness Large Areas in.	Minimum Thickness Small Areas in.
Tin	0·030	0·060	0·030
Lead	0·030	0·075	0·040
Zinc	0·020	0·045	0·015
Aluminium	0·040	0·075	0·045
Magnesium	0·045	0·080*	0·050
Copper	0·060	0·010	0·060

* *Thinner walls allowable if surface finish is not critical.*

the disadvantage of using integral rivets, and it is, accordingly, preferable in many instances to replace the original heavy boss not by a rivet, but by a slender cored-out quill into which a drive-screw may be pressed (Fig 4b, right).

This method is illustrated in more detail in Fig. 5, where two types of quill are shown. That on the left, which is cored out for its whole length, is to be preferred when the surface x is not exposed in service, and stronger quills result when the hole is cored from side X and is radiused in the manner illustrated. This facilitates flow and provides a much stronger quill.

During the last year or so there has been a definite tendency in the U.S. to salvage large castings having superficial defects (where these do not affect the structural strength) by the use of non-shrinking synthetic resin fillers before spray painting. Metal-powder putties have also been tried for this purpose, though, perhaps, not altogether successfully. Nevertheless, the piece-part costs of such large die-cast components as, say, the housing for a rotary grass-cutter, are so high that salvage of castings with only minor imperfections is already becoming essential.

It is inevitable that this trend will continue, as die-castings become larger and better fillings are developed, so that it may soon become generally acceptable for service holes as well as blemishes to be filled in this way. This would certainly give a little more flexibility to coring practice, allowing holes to be cored from either side of a wall. At present, however, it is often necessary to make use of quills with blind holes, as illustrated on the right of Fig. 5.

With either type of quill, it is advantageous to provide an oversize hole in the mating component and, if possible, a pair of integral dowels a little longer than the quills. These locate the sub-assembly with precision in relation to the quills, and so avoid any difficulty that might arise from the presence of a burr at the edge of the cored hole. If the hole in the flange is a little larger than the cored hole in the quill, the flash can enter and assembly is not impeded.

In default of the provision shown in Fig 5, it becomes necessary to face the quills—or at least to deburr them with a cutter of fixed height—just as in a sand-casting. However, this is seldom justified by the need to maintain close limits, since the majority of such assemblies are critical only on dimensions such as A in Fig. 6. Both of these are held from datum faces formed in the same die member as the quills themselves, and thus are subject to little variation.

If, on the contrary, it is necessary to hold dimensions such as B, on the right of the figure, to close limits, this may well necessitate facing off the quills with the casting located by reference to the face x of the large external boss. In this regard, it may be noted that in an application like this last, but using the shouldered rivets of Fig. 4b, it will almost certainly be better to face off the external boss (Fig. 6, right) rather than attempt to hollow-mill the studs, when dimension C is critical.

(To be concluded)

NEW RANGE INTRODUCED BY PROJECTILE AND ENGINEERING COMPANY LIMITED

Cold Chamber Pressure Die-Casting Machine

THREE machines — the 40DC5, 50DC10 and 60DC20—have been introduced by Peco Machinery Sales (Westminster) Ltd., the sales organization of The Projectile and Engineering Co. Ltd., as a new range of Peco die-casting machines. All the machines in the series are hydraulic and semi-automatic.

The most recent addition to the range is the 60DC20 machine, arranged for cold-chamber operation, suitable for the production of aluminium, magnesium and brass castings. For capacities see Table I.

TABLE I—MACHINE CAPACITY

Locking force	750 tons
Die closing adjustable	21 to 32 in.
Die height	35 in. (max.), 19 in. (min.)
Platen size	53 in. × 57 in. vert.
Platen space between tie bars	37⅜ in. × 40⅜ in. vert.
Ejection stroke hydraulic (maximum)	12 in.
Ejection stroke mechanical	4 in.
Shot capacity (aluminium)	26 lb.
Plunger stroke adjustable	18 to 22 in.
Injection ram force	95,030 lb.
Effective plunger stroke	17 in.

In this machine, the locking of the die is by a fully-balanced quick-acting toggle mechanism fitted with hardened and ground toggle pins operating in hardened and ground sleeves.

The opening stroke of the moving platen is adjusted by means of a control device in the locking cylinder.

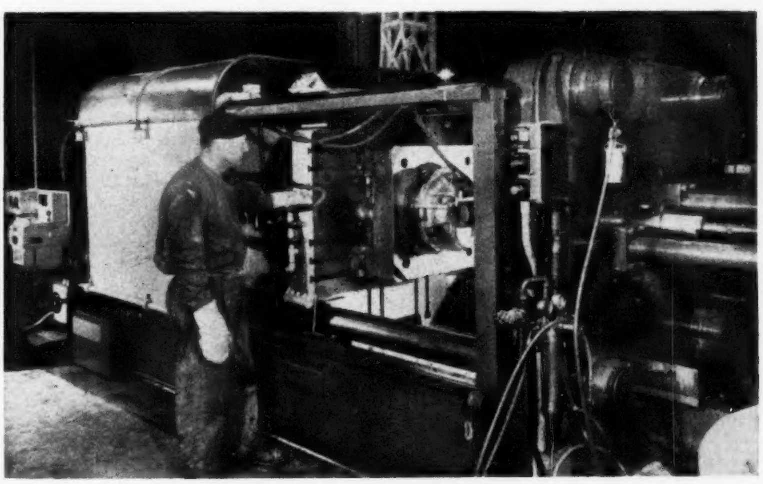
The die height adjustment is carried out by means of a large diameter central screw which ensures equal load distribution over the platen area.

The adjustment system is power-operated, and manual operation can be achieved in an emergency.

The injection unit is mounted on an outrigger fixed to the machine base, and its height is adjustable by means of a hydraulic jack to allow centre or below centre injection.

The injection sleeve and the plunger tip are made of nitrided heat-resisting steel. Both the injection sleeve and plunger are easily removable. A variable length injection plunger rod

The 60DC20 machine in operation at the Berliet Works, France



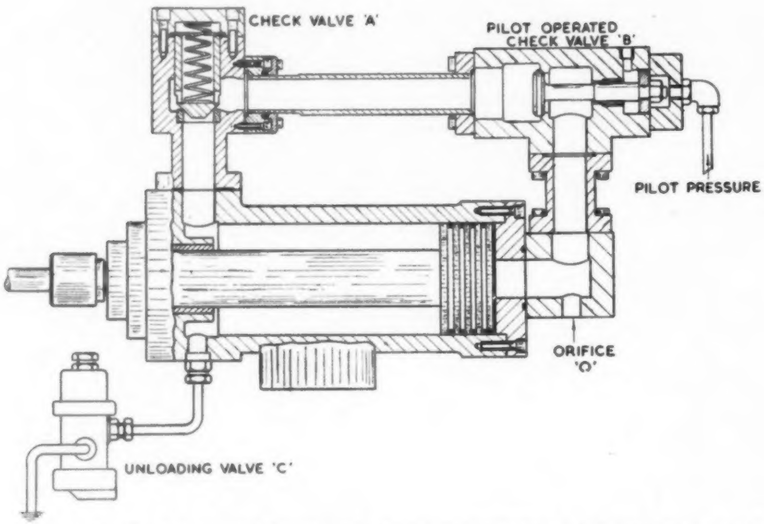


Diagram showing that mounted directly upon the injection cylinder is a check valve 'A', a pilot operated valve 'B' and adjacent an unloader valve 'C'. In operation, oil from the pump is delivered to the rear of the piston via orifice 'O', tending to move it forward. Oil at the ram end of the piston would therefore normally be returned to the tank, but the unloader 'C' prevents this, as at this stage it is closed. The oil is therefore diverted through valve 'A', the pilot check valve 'B' having been opened by the pressure of oil flowing through the pilot line which runs from the tapping on the tee-piece to the pilot check valve actuating piston. Since the area of the injection ram is approximately one-third the area of the piston, the volume of oil passing through the check valves is twice that received from the pump. This causes the piston to move forward at a speed three times that normally obtained. When the plunger meets resistance caused by the molten metal being injected into the die, unloader valve 'C' is opened by the build-up of pressure on the rear of the piston via the pilot line. All oil on the ram side of the piston is then allowed to return to tank, thus relieving the back pressure previously exerted by this oil, permitting the total thrust to be equal to the product of the line pressure multiplied by the area of the piston

is available to accommodate fixed die plates of differing thicknesses.

The injection cylinder unit is constructed to give a fast initial rate of injection, to be followed up with a high pressure slow "squeeze."

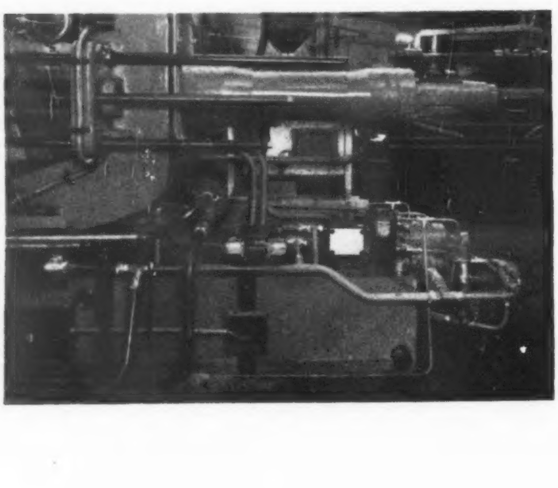
A central hydraulic ejector cylinder is built into the machine and is fully interlocked with all the other machine movements. The ejector may also be used as a central core-puller. This facility is of considerable use as it allows the core to be withdrawn when the dies are closed. When the hydraulic ejector is used as a core-puller, or whenever central ejection is not required, an ejector plate can be used.

All operations are initiated by push button, and the sequence in which individual operations take place during the cycle, before and after injection has taken place, is infinitely variable. A system of interlocking is incorporated which ensures that, when casting, no operation can take place until the one immediately preceding is satisfactorily completed.

The machine is fitted with power-operated safety gates, which are interlocked with the electrical and hydraulic circuits of the machine in such a way that it is impossible for the die halves to close unless the safety gates are shut.

When the machine is operated manually, it is necessary for the operator to close the gates by depressing a button; he then completes the cycle by operating from the electrical control cabinet. When the machine is operated semi-automatically, the action of closing the gates starts the casting cycle.

The use of an assistant operator working the rear of the machine is catered for by interlocking the rear gate with the die safety circuits, thus the die space has to be covered back and front before the commencement of the cycling circuit.



The hydraulic equipment and closing cylinder of the 60DC20 machine

Men and Metals

It has been announced by the British Iron and Steel Federation that **Mr. Lewis Chapman,** chairman of William Jessop and Sons Limited, is to succeed **Sir Andrew McCance,** chairman and managing director of Colvilles Limited, as President of the Federation this year. Elected as President-elect is **Mr. Richard F. Summers,** chairman of John Summers and Sons Limited.

At a recent function, **Sir John Wrightson,** Bart., vice-chairman and managing director of Head Wrightson and Company Limited, made a presentation to **Mr. F. J. Walker** to mark his retirement as a director of Head Wrightson Aluminium Limited after

over 50 years' service with the company. Mr. Walker joined the group in 1904 as a drawing office apprentice. In 1936 he became chief draughtsman at the Teesdale works. During recent years he had been actively engaged in the design and fabrication of light alloy structures, and was concerned with the first aluminium alloy bascule bridges in the world at Hendon Dock, Sunderland, and at Aberdeen.

At the recent meeting of the Aluminium Industry Council, the **Hon. Geoffrey Cunliffe** (British Aluminium Company Limited) was appointed chairman of the council for the ensuing twelve months. At the same meeting, a warm vote of thanks was accorded to the retiring chairman, **Mr. H. G. Herrington,** C.B.E. (High Duty Alloys Limited) for his services to the industry during his two years of office.

News from Martin, Black and Company (Wire Ropes) Limited is to the effect that **Mr. Alexander Johnston,** A.M.I.Mech.E., general manager to the company, has been appointed to the executive board as from January 1.

STRESSES ENCOUNTERED AT LEVELS ABOVE THE ELASTIC LIMIT

Discontinuity in the Fatigue Curve for Duralumin

IN the investigation of the fatigue strength of metals, the stresses which cause failure of the test specimen normally lie below the yield point. In certain applications in which the strength under repeated loading is important, e.g. in aircraft structures, it is quite common to find points of local stress concentration at which the yield stress is, theoretically, greatly exceeded; diffusion of the stress into adjacent parts of the structure reduces the maximum value of stress. Little work appears to have been done on the fatigue properties of materials at higher values of the stress, i.e. stresses in the elastic-plastic region as opposed to the elastic region only, and some recently reported Russian work[1] on the fatigue strength of Duralumin is, therefore, of interest.

The tests were carried out in a fatigue testing machine of 1½ tons load capacity, applying a pulsating tensile load with a frequency of 10 cycles/min. The Duralumin specimens were in the form of strips, of 2·5 mm. thickness, and preliminary tests on the Duralumin gave the following mechanical properties: ultimate tensile strength, 45·9 kg/mm^2; yield point, 33·4 kg/mm^2; elongation, 17·8 per cent.

In the plotting of fatigue curves, care must be taken to distinguish the mean stress and the range of stress; in the fatigue curves shown in Figs. 1 and 2, the maximum stress σ_{max} is plotted against the number of cycles to failure, the minimum stress σ_{min} remaining at 2 kg/mm^2 for all the tests. The figures show typical curves for different types of Duralumin; each point through which the curve is drawn represents the arithmetical mean of a large number of tests at that particular value of σ_{max}, and it is clear that the curve in each case has two distinct branches, with a discontinuity in the region of σ_{max}=32 to 33 kg/mm^2. The lower branch is thus associated with stresses entirely within the elastic range, while the upper branch covers elastic-plastic stress.

Further tests on welded Duralumin specimens produced the same form of curve, while a similar series of curves resulted from trials in which the minimum stress σ_{min} was kept at 10 kg/mm^2.

A suggested explanation of the form of the curve lies in the theory of crystal dislocation, which points to a difference in the mechanism of fatigue failure in the cases of high and low stress. Above the yield point, the major failure mechanism is the coagulation of vacancies on the planes of maximum shear stress, while for lower stresses the build-up of vacancies occurs on planes of maximum normal stress.

Confirmation of this has been given by an additional series of tests carried out on rotating cantilever specimens of circular section. At comparatively low stresses, the fatigue failure takes its normal course, starting from some surface defect and spreading in a plane perpendicular to the axis of the specimen. For higher amplitudes of stress, however, failure occurs on planes at 45° to the axis of the specimen, i.e. on the plane of maximum shear stress.

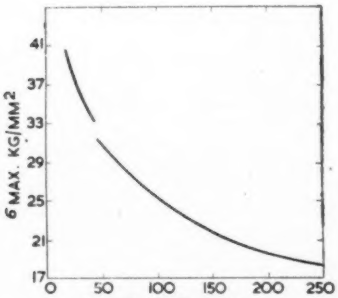
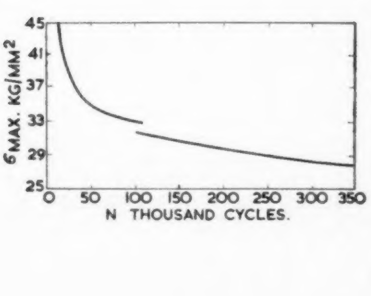


Fig. 1 (above) and Fig. 2 (below)—Maximum stress plotted against number of cycles to failure. Curve derived from the arithmetical mean of a large number of tests on two different types of Duralumin



Reference

[1] V. I Shabalin; *Doklady Akad. Nauk. S.S.S.R.*, 1958, **122**, 4, 600.

Research Progress—*continued from page 6*

preparation is also difficult because of brittleness. Both nickel and platinum-iron baths gave less reproducible and lower results than an iron bath provided the silicon content of the latter was kept below about 6 per cent. Tantalum samples could be satisfactorily analysed using an iron-tin bath, though standards for checking accuracy were not available.

The high-vacuum conditions needed for analysis by this method make the operation and maintenance of the equipment a skilled and specialized occupation. The use of an argon atmosphere has been successfully applied by W. G. Smiley, however, with a reduction in the complexity of equipment. The oxygen in the metal is here evolved, as before, as CO, carried by the argon into a circuit where Schütze's reagent converts the CO to CO_2, which can then be removed by condensation and later measured. Although a large number of metals have been analysed in this way, little information is given by Smiley about the accuracy and reproducibility of the method except when applied to the determination of oxygen in plutonium. Here, oxygen was in some cases added to check the completeness of recovery, and satisfactory correlation between the amount added and that analysed was obtained.

Finally, mention must be made of the Symposium Paper by V. A. Fassel, W. A. Gordon and R. W. Tabeling describing the development of a spectrographic method of determining oxygen in metals. As stated previously, arcing in air cannot be used because of the masking effect of oxygen in the atmosphere. This difficulty, and the problem of standards, was ingeniously overcome by sparking the sample in contact with carbon in an atmosphere of argon. Oxygen passes into the argon as CO and, after a short period during which this reaction is completed, the spectra of the gases passing through the arc are examined. The oxygen lines (particularly that at 7,771Å) are compared with the argon lines (e.g. 7,891Å) which are thus used as "internal standards." Extremely consistent calibration relationships between the relative intensities of these lines and oxygen content have been obtained for titanium alloys and for lanthanum. The accuracy obtainable appears to be as good as, or better than, that of the vacuum fusion method, but the time required for determinations would be very much shortened.

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A REVIEW OF NON-FERROUS ACTIVITIES IN 1958

Base Metal Markets

BY OUR METAL EXCHANGE CORRESPONDENT

TO say that the year just closed has seen disturbances and upsets of one kind and another in the non-ferrous metal markets is virtually to state that the period under review was in much the same pattern as previous years. Roughly, the year 1958, for the purpose of this review, falls into two parts, the first quarter, during which the adverse spill-over from 1957 was still in evidence, and the following nine months, when the situation improved very greatly. A recovery began on Wall Street, and initially it looked as though the optimism shown by investors was misplaced, but as the months went by it became apparent that the economy of the United States was steadily improving and that the recession was on the way out. In November, it is true, there was a very sharp setback, which, however, lasted little more than 24 hours, after which steadiness reappeared. However, it seems likely that for the present the rise has just about reached its top and, moreover, there are some signs that the recovery in steel production is now flattening out. However, there cannot be any doubt that the situation in the United States now is very greatly improved in comparison with 12 months ago.

In this country, too, there has been a noteworthy and most satisfactory return of confidence, although the year ended with evidence of unemployment and an indication that, in the non-ferrous industry at any rate, orders are not now coming in as satisfactorily as they were a few months ago. The credit squeeze is now a thing of the past, as evidenced by the reduction in Bank Rate over the year from 7 per cent at the beginning to 4 per cent at the end. Strikes at home and overseas have again been a feature of the scene, while the international situation continues to give cause for anxiety. Once again there has been tension and trouble in the Middle East, and in July a military coup occurred in Irak. Details of consumption of non-ferrous metals in the United Kingdom for the first ten months of 1958 show that activity, at any rate to that point, had been very well maintained. The total for copper, including secondary metal, was about 14,000 tons up on the corresponding period in 1957.

Last year we again saw Governments interesting themselves in metals, and in this country, quite apart from the normal sales of scrap by the disposal sections, the Board of Trade in the autumn released from their stocks upwards of 20,000 tons of copper, which, it was understood, found ready buyers. Current opinion is that there may well be some further releases in the New Year. At the end of April the United States Government announced its guaranteed price scheme under which the authorities undertook to guarantee a price of 27½ cents for copper, 14¾ cents for lead and 12¾ cents for zinc in respect of a very substantial tonnage. This plan was tabled as an alternative to increased import duties but it was not implemented, and in due course the so-called Minerals Stabilization Bill, under which it was proposed to stockpile 150,000 short tons of copper, came before the House. After a prolonged debate, and when success seemed certain, the measure was thrown out on August 22. However, in the meanwhile an import duty of 1·70 cents per pound on foreign copper became effective from July 1. On August 15, the British Government announced that non-ferrous metals, excepting nickel, would be on the free list for export to Iron Curtain countries.

Copper

The build-up of Metal Exchange stocks culminated early in January at about 20,000 tons and the decline in the price apparent in 1957 reached its nadir in February at £160 10s. 0d. The quotation was depressed all through the month, but there was a turn round in March when an improvement to £179 was seen. Early in January the custom smelters' price dropped to 25 cents, and the month brought a crop of announcements from producers on both sides of the Atlantic that production was to be reduced. However, the American quotation continued to fall in the face of poor business, and at the end of February stood at 23 cents. This month also saw the commencement of the European c.i.f. electro price, based on the weighted average of sales in Europe by a number of producers. To date, it would seem that this addition to the copper pricing system has not become an effective influence.

The turn of the tide in copper came in March, when, in spite of unfavourable February statistics, a speculative buying movement was launched on the New York Commodity Exchange. By that time, copper production everywhere had been well pruned, and it was not difficult to convince operators that the price of the metal was due for a rise. The custom smelters' quotation, which had finally bottomed at 23 cents, advanced to 24 cents, assisted by the threat of a strike at Chuquicamata. This actually began on April 1, and was not settled until May 21. This stoppage did not have any great effect on the market, for £182 cash and £184 5s. 0d. three months was the best level seen in May. During April, the custom smelters' price dropped ½ cent to 23½ cents, and then rose to 23·75 cents. Both Anaconda and Phelps Dodge announced further production cuts in May, and the smelters' price at the end of the month was 24¼ cents.

June saw the market moving ahead, and an upward movement began in the American domestic producers' quotation, which had been at 25 cents. Standard copper, after touching £206, ended the month at £196, the contango by this time having diminished substantially in line with the decline in L.M.E. stocks, which stood at 13,757 tons. In the middle of the month, the U.S. Government's plan to stockpile 150,000 tons of copper was put forward and the standard market jumped £10 on this news. The scheme provided for the purchase of the metal at 27½ cents over 12 months, but to stockpile copper at a time when voluntary curtailment of output was in being seemed very strange. At the same time, consumption was improving, and it was fairly generally felt that the plan was undesirable. In the event, as already mentioned, the Bill was thrown out and the standard market suffered a spasm of weakness, losing about £8 on one market.

Towards the end of the month, it was reported that a strike was about to break out at the Braden mine in Chile, but within a short time this danger passed. The import duty of 1·70 cents was imposed on July 1, but this had no effect on the London market. July saw a firm market developing, and on the last day of the month cash closed at £208 5s. 0d. and three months at £208 10s. 0d., following the advance in the States to 26½ cents by both custom smelters and producers. Towards the end of the month, too, came reports from Paris of the easing of strategic controls on the export of copper to Iron Curtain countries. Early August saw the custom smelters up to 27 cents, but within a week they were back at 26½ cents again, following an announcement by Kennecott of a 25 per cent increase in output. In the middle of the month the ban on exports to the Iron Curtain countries was lifted, and a week later the Minerals Subsidy Bill was rejected. Before the end of the

month, buying by Russia was reported. The month closed at £202 15s. 0d. for cash and three months. Early in September a short-lived strike broke out at Kennecott's Utah mine and Phelps Dodge announced an increase in production. On September 10, it was known that a Rhodesian strike ballot had shown an overwhelming majority in favour of a strike, and this broke out on the night of September 12.

Throughout the month the standard market was active and firm, £213 10s. 0d. being reached, for on September 24 a strike began at the International Nickel Company's property, which ended on December 22. Early in October, custom smelters advanced to 27 cents, and later, by successive stages, to 30 cents, while the producers went up to 29 cents. With the ever-increasing demand for copper, due to the anticipated gap in supplies from the Copperbelt, the London market advanced rapidly and the month ended at £252 cash and £238 forward, a serious backwardation developing, with stocks standing at little more than 6,500 tons. The premium for cash showed itself first early in October, and grew greater as the month went on, reaching its highest on November 5, when cash stood at £258 10s. 0d. and three months at £240 10s. 0d. This was the day when the Rhodesian strike came to an end after lasting for 53 days. The top of the rise was reached on the afternoon of the following day, with cash at £261 and forward at £247. Almost at once the market began to decline, £238 for cash and £234 5s. 0d. for three months being reached on November 14, but news that world stocks of copper at October 31 had fallen by 106,000 short tons caused a brief rally to £244 10s. 0d. cash and £242 forward. L.M.E. warehouse stocks had dropped to 5,979 tons on November 10, but thereafter a gradual improvement set in.

The downward trend in November was accelerated by two Board of Trade releases during the month totalling 17,500 tons and some signs of a reaction on the Commodity Exchange in New York, where, on November 25, the turnover amounted to nearly 15,000 short tons. Another bear point for the market was the U.S. Government's decision to do away with end use certificates, which meant that American copper could be delivered on the London market. November's low point was £223 15s. 0d., but £219 10s. 0d. had been traded. On the afternoon market on December 3, cash stood at £217 5s. 0d., but by December 11 there had been an advance to £222 15s. 0d. Thereafter minor fluctuations were seen, a modest fall occurring on the November statistics, showing world stocks 32,500 tons down, which was regarded as disappointing. Two days before Christmas custom smelters were reported at 29 cents, with the London market at £221 10s. 0d. Anaconda announced a plan to raise Chilean output in 1959.

Tin

The year opened with cash at the support price of £730, which rose to £737 on January 30, with three months at £736. In the middle of the month, the forward quotation stood at £705, to which it had fallen from £729 on fears that the Council might not be able to continue its support. February saw another upward flurry to £738 cash and £740 three months, but by the end of March values were back to the support level. Little change occurred in April, but cash was seen at £735. In May it was announced that export quotas would remain unchanged for the third quarter, and the market touched £737 for cash and as much as £741 for three months. By the end of the month L.M.E. stocks had risen to 18,874 tons, from 12,122 at December 31, and it was generally assumed that this metal was owned by the Tin Council. June showed some weakness due to lack of demand, and the forward price, after touching £736, dropped back to £725 10s. 0d. For many weeks offering of Russian tin on the market had been a depressing factor and it was announced by the Chairman of the Tin Council that Russia had been approached to join the scheme. July saw the forward price between £729 and £740, the rise being due to an announcement by the Tin Council that exports for the fourth quarter would be cut by 48 per cent instead of by 40 per cent as previously.

In face of the ever-increasing tonnage of Russian tin entering the U.K., the Board of Trade announced that imports of tin from China and Russia would be restricted to 750 tons per quarter, in order to safeguard the operation of the tin agreement. This news came out in time to influence late Kerb dealing on the afternoon market and the price shot up by about £7. On September 1 the price stood at £746 cash and forward, but this was not held and the market dropped back to around £730. On September 18, there occurred perhaps the most dramatic event in the history of the tin market, for, during the second ring, dealings were suspended, as it was found that the Pool had withdrawn its support. Dealings were resumed in the afternoon, and the quotation plunged down to £645 cash and £642 10s. 0d. three months, these prices being nominated as the official quotations for the day. Twenty-four hours later the market had improved to £680 cash and £670 three months, and by the end of the month there was a further improvement to £724 cash and £714 forward. On American buying, and influenced to some extent by the firmness of copper, the tin market forged ahead in October, and the month ended with cash at £750. So far as is known, no further support buying has taken place, and in November the cash quotation ranged from £748 10s. 0d. to £765, three months being about the same. There is no indication that Russia has joined the Tin Pool scheme. Throughout most of December the price ranged either side of £760, but before Christmas selling of the cash position brought the price down to £753. L.M.E. stocks declined and on December 22 stood at 16,088 tons.

Lead

The year opened with lead at £72 5s. 0d., dropped to £71, and finished the month at £73 10s. 0d., after being up to £74 5s. 0d., while in February £76 5s. 0d. was reached but not maintained. March saw fluctuations between £73 10s. 0d., and £76, but on April 1 the U.S. price dropped by 1 cent to 12 cents and the lead market declined to £71 15s. 0d., but a flurry of strength on the news of the American guaranteed price scheme, which envisaged lead at 14¾ cents, sent the price up to £75 10s. 0d. for one market at the end of the month. In mid-May, the U.S. quotation dropped back to 11½ cents, for it seemed unlikely that the stockpiling of this metal, due to come to an end, would, after all, be continued. It was reported that the U.S. Tariff Commission had recommended that the tariff on lead should be increased. May saw lead between £70 12s. 6d. and £73 12s. 6d. In June, the metal had a low of £70 15s. 0d., but also a brief rally to £78 5s. 0d. on the news that Canada was cutting her production. On July 2, the U.S. price was again reduced to 11 cents and our market broke £70, and on August 21 stood at £68, the lowest since 1947. This month the U.S. Senate Interior Committee rejected the idea of stockpiling and brought forward a subsidizing plan instead, and a prominent U.S. producer cut output by 20 per cent. October brought a rise in lead to 12¾ cents, and London touched £77 15s. 0d., for during this month all the metals were firm. At the end of November the quotation stood at £76 5s. 0d. In the autumn, an import quota system was introduced by the United States, and a plan to barter against farm products was mooted. Poor demand brought a downward trend in December to £72 on Christmas Eve.

Zinc

The year began with zinc at about £62, but by January 30 the quotation was up to £64 15s. 0d., a level not reached during February. During that month the question of revised U.S. import duties cropped up, and in March it was announced that stockpiling of zinc in the States would be given up. No improvement occurred in the London price, which failed to rise above £64 5s. 0d. during March,

(*Continued on page* 15)

Industrial News

Home and Overseas

New London Headquarters

Some 20,000 ft^2 in Brook House, Park Lane, London, has been acquired by **Metal Industries Ltd.** as its London headquarters.

Metal Finishing

One of the first meetings in the New Year of the **Institute of Metal Finishing** is that to be held on Tuesday next (January 6) by the members of the Midland branch at the James Watt Memorial Institute, Great Charles Street, Birmingham, 3, at 6.30 p.m. The speaker on this occasion will be Mr. J. M. Sprague, who will take as his subject "Cyanide Plating Solutions."

Swiss Export Controls

It was announced in Berne last week that the Swiss Government had revised export control legislation. Under the revised arrangements, export licensing will be further simplified and its scope reduced, particularly for certain non-ferrous metals, machinery and chemicals. It has also been decided that consignments weighing not more than 20 kilos gross weight might be exported freely, the announcement said. Aluminium is one of the metals freed under the new legislation. However, the Government wishes to keep a check on the export of aluminium scrap and, consequently, an export duty has been imposed on this item.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange warehouses last week amounted to 16,068 tons, and were distributed as follows: London, 5,946; Liverpool, 8,612; and Hull, 1,510. Stocks of refined copper were as follows:—London, 3,725; Liverpool, 1,696; Manchester, 250; and Birmingham, 150.

Twenty-Five Years

No fewer than sixty employees of **Northern Aluminium Company Limited** commemorated twenty-five years' service with the company at celebrations held during last month. Those attaining their silver jubilee with the company during the past year included fifty-one from Banbury, six from Birmingham, two from Rogerstone, and one from the Central Technical Division.

On this occasion, in place of the aluminium pocket watch that, until the previous year, had been presented as a memento of the event, employees received either an aluminium clock specially made for this purpose or a gold wrist watch, whichever they preferred.

The clock, which is all-aluminium except for the movement, is by E. Dent and Co. Ltd. The case is ingeniously made of gold-anodized extruded sections, the fascia plate is of an impressed pattern which has been anodized slate grey, and the dial and fluted dial plate behind it are in natural finish.

Australian Aluminium

A technical mission which has just completed an inspection of the Bell Bay aluminium works will report to its principals in Britain on the proposal that they should invest capital in the works to assist expansion. The Tasmanian Premier, Mr. E. Reece, said that he had held discussions with members of the mission before they left for England. There was a possibility that British Aluminium Company Limited would be admitted as a third partner in the project. The Commonwealth and Tasmanian Governments are joint partners at present.

Mr. Reece said that as it was not yet known whether the proposed partnership would be accepted, or how long it would be before a decision was made, the Tasmanian Government planned to assist in the first stage of expansion with an immediate investment of A£1,500,000. A Bill to authorize this was now before Parliament.

Canadian Aluminium Cut

It has been reported from Montreal that the Aluminum Company of Canada, operating subsidiary of Aluminium Limited, will reduce its smelter production by ten per cent in January. This will bring the annual rate of production down to 500,000 tons from the 620,000 tons rate prevailing up to July 23, 1958. On that date, the rate was reduced to the current level of about 560,000 tons annually. Present installed capacity is about 770,000 tons.

Training Courses

To meet the demand for an intensive full-time course in polarography, the **British Polarographic Research Institute** has made arrangements for a five-day training course to be held during the week January 12-16. The object of the course is the provision of basic training in the theory and practice of polarography, and will include lectures, directed reading and practical exercises in direct current, alternating current, cathode ray and square wave polarography.

Full details of this course may be obtained from the secretary of the Institute at 55 Oriental Road, Woking, Surrey.

Anti-Scuffing Lubricant

An entirely new product—Anti-Scuffing Spray—in an aerosol pack has now been introduced by **Rocol Ltd.** This spray contains a basis of molybdenum disulphide of particle size best for surface treatments, and bonding resin to effect retention of a film, plus a propellant. The vapour is non-toxic, non-corrosive, and not harmful or offensive to human beings. The spray is used for the production of a hard bonded lubricating film of molybdenum disulphide on metal or plastics surfaces.

Russian Tin for Japan

Three Japanese trade firms had signed contracts to import 240 tons of Soviet tin in barter for about 1,000 tons of wire rope, the Daiichi Tsusho Kaisha, one of the three firms, announced last week. The tin would be to a minimum 99·56 per cent purity. The contract prices would be £4 sterling lower than the average of prices in the London market during the three days prior to shipment. The shipments would range from January to March this year.

Another group of three Japanese trade firms was negotiating for imports of 180 tons of Soviet tin, the Sansho Trading Company, one of the three firms, said. The quality and prices of the Soviet tin under negotiation were the same as those for the first group. The three firms would ship 1,700 tons of silicon steel sheets to the Soviet Union in exchange for the tin. Sansho said Japan hoped to import about 1,000 tons of Soviet tin under a new Soviet-Japanese trade plan signed in Moscow last month. This would be in addition to about 500 tons imported earlier this year under the previous trade plan.

Extruded Aluminium Gratings

For some time past, **Archibald Low and Sons Ltd.,** of Glasgow, have been manufacturing and marketing a type of aluminium grating known as "Alaflor." These grid gratings and treads have found a ready acceptance in the marine industry. The grating is supplied rectangular, square punched or plain, and great strength and rigidity are claimed to be the result of the I-beam extrusion principle employed. Panels are formed by welding together 6 in. wide extrusions

Left to Right: Mr. L. Fletcher, works manager, Mr. C. P. Paton, director, Mr. S. E. Clotworthy, managing director (holding presentation clock) and Mr. B. N. H. Thornely, director, with the six employees of Northern Aluminium Co. Ltd., who recently celebrated 25 years at the Birmingham works.

and banding the open ends with aluminium alloy flat bars.

Longitudinal serrations and a raised tip at either end of the punched pattern prevents forward or sideways slip. The large open area reduces wind resistance, and gives adequate visibility and passage of light and air. Insulation against bi-metal corrosion between the aluminium and mild steel members is provided, and fixing bolts are made from stainless steel or, alternatively, cadmium plated mild steel, according to the location of the installation.

Scrap Metal Trade Lectures

Following our previous announcement of the series of eight lectures on the subject of "Technological Aspects of the Non-Ferrous Scrap Metal Industry," which are to be given at the College of Technology, Birmingham, on successive Wednesdays, commencing on January 28 next, we now give below the subject matter of each lecture, together with the names of the lecturers. The fee for admission to the course is two guineas, and application should be made to the Department of Metallurgy, College of Technology, Gosta Green, Birmingham, 4.

The syllabus is as follows:—

"Metallurgical Background of the Non-Ferrous Scrap Metal Industry." Dr. I. G. Slater, Head of Department of Metallurgy.

"Copper and Copper Base Alloys." Mr. H. J. Miller, M.Sc., F.I.M., I.C.I. Metals Ltd.

"Light Alloys." Dr. E. G. West, Aluminium Development Association.

"Other Non-Ferrous Metals and Alloys, including Lead, Tin, Zinc, Nickel." Mr. J. A. Dalziel, A.I.M., Visiting Lecturer, Department of Metallurgy.

"The Sampling of Non-Ferrous Scrap Materials, Their Analyses and the Control Techniques Commonly Used." Part I. Mr. S. J. Silk, A.C.T.Birm., F.R.I.C., A.I.M., Visiting Lecturer, Department of Metallurgy.

"The Sampling of Non-Ferrous Scrap Materials, Their Analyses and the Control Techniques Commonly Used." Part II. Mr. J. B. Atkinson, B.Sc., A.R.I.C., F.I.M., Senior Lecturer, Department of Metallurgy.

"Principles Involved in the Sorting, Melting, Refining and Casting of Scrap Metals." Mr. S. J. Silk, A.C.T.Birm., F.R.I.C., A.I.M., Visiting Lecturer, Department of Metallurgy.

"Commercial Practice in the Non-Ferrous Scrap Metal Trade." Mr. Victor Brenner and Mr. G. Levy, Members of the Council of the National Association of Non-Ferrous Scrap Metal Merchants."

Metallurgical Society

At their first meeting of the New Year, the **Birmingham Metallurgical Society** is to hear an address by Dr. I. G. Slater, M.Sc., F.I.M., on the subject of "Metallurgical Education in the U.S.S.R." The meeting will be held on Thursday next, January 8, in the Byng Kenrick Suite of the College of Technology, Birmingham, at 6.30 p.m.

Luncheon Club Meeting

At the Christmas meeting of the **Finishing Luncheon Club,** held in London, there was an attendance of some 60 members, with Mr. Jack Train as the principal guest. The opportunity was taken at this meeting of entertaining Mr. F. J. Potter, the general secretary of Dr. Barnardo's Homes, and of presenting to him a cheque value £50, representing the annual contribution of the club members to that charity. In the absence of Mr. W. F. Wilson, chairman of the club, the function on this occasion was presided over by Mr. J. N. T. Adcock (I.C.I. Paints Division).

Fusion of Atoms

A small exhibition is being staged at the Science Museum in London until the end of March this year, illustrating British research in the field of controlled fusion of atoms. The centrepiece of the exhibition is a one-third scale model of "Zeta," the apparatus developed at Harwell. This model was shown in the exhibition held at Geneva last September in connection with the Second International Conference on the Peaceful Uses of Atomic Energy, and simulates the flashing discharge which in Zeta produces fusion of atoms.

Another scale model, which was on view for six months at the Brussels World Fair, shows the apparatus known as "Sceptre III," which was made by Associated Electrical Industries Ltd. and gives results similar to those obtained with Zeta. Examples are also shown of pioneer apparatus used at the beginning of this type of work some twelve years ago.

An Order from Russia

In connection with the paragraph under the above heading which appeared in our issue of 19 December (page 521), relating to an order which had been received by **The Bronx Engineering Co. Ltd.** from V/O. "Stankoimport," Moscow, we understand that the actual value of the order was £32,000, for eight tube straightening machines. The machines ordered range in sizes for dealing with tubes from $\frac{1}{16}$ in. to $2\frac{1}{2}$ in. diameter, and are complete with inlet and outlet troughs for tube handling purposes.

Philippine Copper Production

News from Manila is to the effect that a total of 3,800,426 lb. of copper was produced during November by Atlas Consolidated Mining and Development Corporation. The company's monthly report announced that the Corporation's Toledo mine treated 344,292 tons of ore, averaging 0·66 per cent copper. Copper concentrates produced totalled 7,196 short tons. In the previous month 333,149 tons of ore, averaging 0·69 per cent copper, was treated; 7,197 dry short tons of copper concentrates were produced containing 3,955,587 lb. of copper.

Lepanto Consolidated Mining Company produced 2,400,720 lb. of copper during November, against 2,497,360 in October.

Swiss Scrap Duties

It is reported from Zurich that the Swiss Government has abolished export licensing for aluminium scrap, but has imposed the following export duties from January 1, in francs per 100 kilos:—aluminium scrap, plate waste, foil waste, containers, etc., 35; aluminium shavings, 30; and aluminium filings, 10.

Lightweight Barrel Skid

A new aluminium alloy barrel skid has recently been introduced by **Powell and Company,** of Burry Port. This skid is made to an exclusive design and specification, combining maximum strength with lightness. The runners have wood battens positioned along the top of the metal section, and these can be easily replaced if worn. The skid is fitted with steel hooks, and it is available in three standard lengths of 8 ft., 10 ft., and 12 ft.

Welding News

Starting on a major tour this week, Mr. R. W. Ayers, managing director of **Sciaky Electric Welding Machines Ltd.,** is visiting South Africa, Australia, New Zealand, Ceylon, and India. The primary purpose of the tour is to visit the company's agents and to extend the field of Sciaky activities in these countries. Mr. Ayers will be away about three months.

Soviet Output Ahead

News from Moscow states that the Soviet non-ferrous metal industry has fulfilled this year's production plan ahead of schedule, the Soviet Central Statistical Board announced. By the end of this year, the announcement adds, output of copper, aluminium, lead, zinc, nickel, magnesium, cobalt, tin, titanium, and molybdenum will be considerably in excess of the plan targets.

B.I.C.C. New Appointments

It has been announced by **British Insulated Callender's Cables Limited** that Mr. G. N. Blades, A.M.E.M.E., is appointed regional manager, London, in succession to Mr. E. A. Sayers, who retired at the end of last year. Mr. Blades was formerly divisional sales manager (Rubber Cables) at the Leigh works, and this position has been taken by Mr. D. I. S. Hinton, B.A. (Mech. Science). Prior to his official appointment, Mr. Hinton was the B.I.C.C. Sales Engineer (Aircraft).

Base Metal Markets—*continued from page 13*

and April was no better. The American March statistics were poor and rather pin-pointed what a poor state of affairs existed in zinc. May was a poor month, for £63 7s. 6d. was the highest point reached for the current month, the lowest being £61 2s. 6d. There was talk about the likelihood of the U.S. import duty on zinc being increased, and this cheered the American market. In London, the price began to move up on news that the New Jersey Zinc Co. was reducing to 50 per cent output at two of its smelters. Early in July the idea of stockpiling zinc in the States was finally rejected, and eventually an import quota scheme was adopted. June saw the price here as high as £66 5s. 0d., but July brought a somewhat easier trend. Little change was seen in August or September, but on October 30 the zinc quotation, at £74 5s. 0d. was above that of lead. By early November the U.S. price had risen to $11\frac{1}{2}$ cents, and the prompt price rose to £77 15s. 0d. on November 20. An easier trend in December brought a reduction to £74 15s. 0d., following earlier firmness when rumours of a U.S. barter scheme temporarily encouraged the market.

Metal Market News

FULL details of the October consumption of the four metals under review in this report reveal an all-round improvement on September and suggest that the report of the full period when it is available will show that 1958 was a very good year. The figures are, of course, published by the British Bureau of Non-Ferrous Metal Statistics, and certainly make good reading. Consumption of refined copper was 53,937 tons, against 52,018 tons, while secondary amounted to 11,253 tons, compared with 9,390 tons. Stocks in the U.K. decreased sharply from 85,092 tons to 74,686 tons. Stocks of lead were also lower, the October figure of 40,216 tons replacing 48,865 tons at the end of September. Consumption of lead, at 31,356 tons, was about 2,500 tons up. In zinc, usage rose from 19,719 tons to 22,269 tons in slab zinc, while secondary went up from 7,028 tons to 7,569 tons. Stocks at 39,341 tons showed a drop of 6,443 tons on the previous month. Consumption of tin amounted to 2,072 tons, against 1,784 tons, while stocks, at 20,135 tons, were about 200 tons down. In copper consumption, the improvement of this year over last, i.e. 1958 over 1957, was due almost entirely to an increase in the tonnage absorbed in the manufacture of H.C. copper wire, doubtless in satisfaction of Russian orders. Under this head the total for the 10 months would appear to be up by about 14,000 tons.

Due to the Christmas holidays, the volume of trading on the Metal Exchange last week was relatively low. Business came to an end at midday on Wednesday last and the Exchange did not re-open until Monday last. Yesterday trading was again suspended, as the Metal Exchange was closed on New Year's Day. Business with consumers was, not unnaturally, quiet last week, and quiet conditions have ruled this week also, markets in many Continental countries being closed yesterday. Last week opened on a cheerful note, for it was announced that the strike at the Sudbury plant of International Nickel Co. had at long last been settled. This dispute, which began on September 24, had lasted for 87 days. Full operation is expected to begin to-day, January 2. Further copper news consisted of details of Anaconda's plan to increase production in Chile. Throughout the pre-Christmas period, Wall Street put up a reasonably good show and the London Stock Exchange ruled firm. On Tuesday, the copper smelters advanced their quotation to 29 cents all round, so that it is not surprising the standard copper price held very steady.

Stocks in L.M.E. warehouses rose by 25 tons to 5,971 tons, and the standard market, after a turnover of less than 5,000 tons, including Kerb dealing, showed a loss of £1 in cash and 15s. in three months. The close was £222 cash and £221 15s. 0d. forward. Although the turnover in tin was about normal for only five markets at 440 tons, cash came under pressure and the close, at £754, showed a loss of £4. Three months was down by only £2 10s. 0d. at £756 10s. 0d., so that the contango widened to £2 10s. 0d. Stocks of tin in official warehouses recorded a further reduction of 295 tons to 16,088 tons, so that the downward trend continues. About 2,050 tons of lead changed hands, with little change in values, for December lost 15s. and March 10s. In zinc, the turnover amounted to 2,500 tons, December closing at £74 15s. 0d., a loss of 10s., and March at £72, which was 5s. below the previous Friday.

New York

Non-ferrous metals have been quiet, reflecting the holiday. Copper sources said the domestic consumption of refined copper by brass and wire mills, and by non-ferrous metal foundries, in November, which amounted to 110,487 tons, was at a satisfactory rate and more indicative of real consumption than the 138,017 tons for October. The October figure was the largest for any month since the boom year of 1955, and represented the inclination of consumers of fabricated products to get the material before the price advanced. Tin was quiet and steady. Lead and zinc were quiet.

For the U.S. aluminium industry the New Year will bring a further expansion of primary capacity and more intensive marketing efforts than ever before, Mr. R. S. Reynolds, Jnr., President of Reynolds Metals Co., has stated in a year-end review. He said: "We look for increased sales in 1959. During 1958, aluminium shipments to consumers totalled 1·8 million tons, a decline of eight per cent from the 1·925 million total of 1957. This was due to the general business downturn in the first half of the year, particularly in the hard goods sector." He noted that aluminium began its recovery much earlier than the general economy, and that it had continued to advance, confirming experience that in periods of rising business activity, aluminium increased at a faster pace than the general economy. As a result, he said, Reynolds Company sales in 1958 would approximate the 446 million dollars recorded in 1957.

Largest increases in aluminium usage in 1959 are anticipated in the construction and transport fields. In 1959, for the first time, six primary producers would be in operation throughout the year. Primary production in 1958 would total 1·55 million tons, as compared with 1·68 million in the peak year of 1956, and total aluminium supply, including scrap and imports, would be 2·15 million tons, down about 150,000 tons for the year.

Mr. Reynolds said the difference between total shipments to consumers and total supply during the past year was accounted for mainly by stockpiling. But stockpile contracts had now been largely completed. Reynolds Metals would have the right, in 1959, to deliver 38,000 tons. Reynolds was completing its new 100,000-ton capacity plant at Massena, New York. The opening of this new reduction facility in 1959 would raise Reynolds' capacity to 701,000 tons a year.

Scrap copper was very steady during the week-end and was latterly quoted at 23 cents per lb. for No. 2 basis, up ½ cent per lb. Offerings were meagre. Traders said that conditions were quiet, partly reflecting the holiday season. There was a firm undertone in custom smelter copper, with the price now quoted at 29 cents per lb. at all custom smelters.

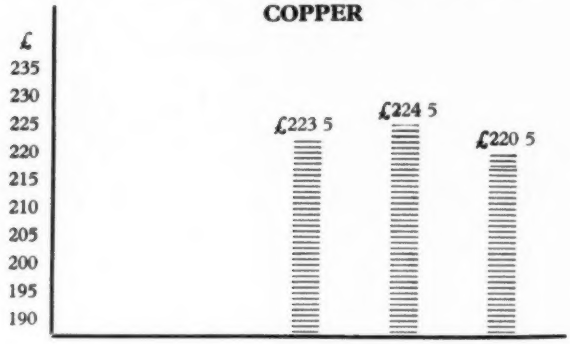
Birmingham

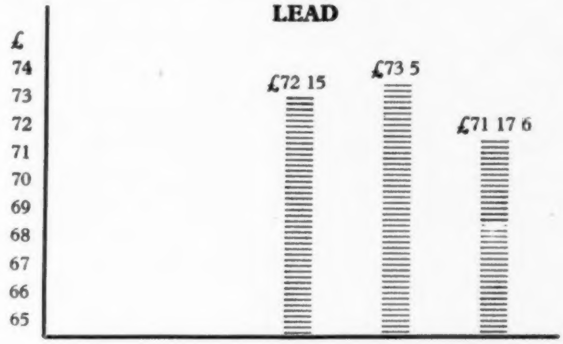
Business is gradually returning to normal following the Christmas break, but stocktaking is in progress at many works. The New Year begins on a note of caution. On the one hand, the optimists already see signs of expansion of trade, and there is at least some basis for this, in that since hire purchase restrictions were removed there has been a distinct improvement in sales of household appliances in which non-ferrous metals play quite an important part. There are, however, other industrialists who take the view that several months may elapse before real revival can be expected, and they instance the lack of orders in some of the chief Midland industries, such as cycles and machine tools. The motor trade is flourishing, and is expected to maintain a high rate of production during the coming year.

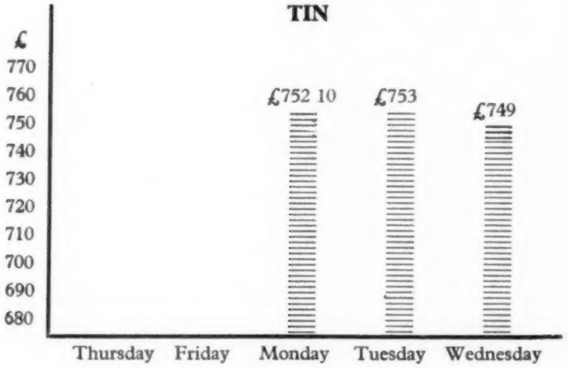
Conditions in the iron and steel industry are still unsatisfactory for many branches. Despite the activity in the motor trade, there is still quite a lot of unemployment and short-time working due to lack of orders in steel works and foundries. In 1958 there was a gradual slowing down of specifications for heavy structural steel, and there is no sign yet of any resumption of enquiries for heavy joists and sections. Pressure for heavy plates eased considerably, so that customers were able to obtain supplies more readily and with less waiting time for delivery. Unemployment in the foundries seems likely to continue for a short while, at any rate. On the whole, stocks of steel in consumers' hands are less than they were six months ago, but there is still a surplus which merchants and manufacturers are anxious to liquidate.

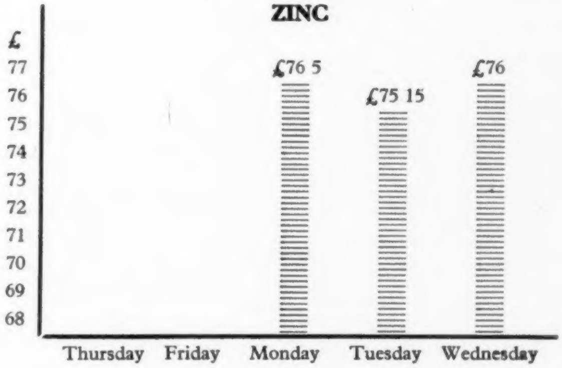
METAL PRICE CHANGES

LONDON METAL EXCHANGE, Monday 29 December 1958 to Wednesday 31 December 1958









OVERSEAS PRICES

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ≏ £/ton		Canada c/lb ≏ £/ton		France fr/kg ≏ £/ton		Italy lire/kg ≏ £/ton		Switzerland fr/kg ≏ £/ton		United States c/lb ≏ £/ton	
Aluminium			22.50	185 17 6	210	182 15	375	217 10	2.50	209 0	26.80	214 10
Antimony 99.0					195	169 12 6	445	256 2 6			29.00	232 0
Cadmium					1,500	1,305 0					145.00	1,160 0
Copper												
Crude												
Wire bars 99.9							435	252 7 6				
Electrolytic	31.00	226 12 6	28.00	231 5	268	233 2 6			2.95	246 12 6	29.00	232 0
Lead			11.75	97 0	115	100 0	176	102 0	.90	75 5	13.00	104 0
Magnesium												
Nickel			70.00	578 5	900	783 0 0	1,300	754 0	7.50	627 2 6	74.00	592 0
Tin	107.25	784 0			940	817 15	1,460	846 17 6	9.00	752 10	98.87	791 0
Zinc												
Prime western			11.50	95 0 0							11.50	92 0
High grade 99.95			12.10	100 0 0								
High grade 99.99			12.50	103 5 0								
Thermic					107.12	93 2 6						
Electrolytic					115.12	100 2 6	175	101 10	.91	76 0	12.75	102 0

NON-FERROUS METAL PRICES

(All prices quoted are those available at 2 p.m. 31/12/58)

PRIMARY METALS

		£	s.	d.
Aluminium Ingots....	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%..	„	190	0	0
Antimony Oxide......	„	180	0	0
Antimony Sulphide Lump..............	„	190	0	0
Antimony Sulphide Black Powder........	„	205	0	0
Arsenic..............	„	400	0	0
Bismuth 99·95%......	lb.		16	0
Cadmium 99·9%	„		9	6
Calcium	„	2	0	0
Cerium 99%	„	16	0	0
Chromium	„		6	11
Cobalt	„		16	0
Columbite.... per unit			—	
Copper H.C. Electro..	ton	220	5	0
Fire Refined 99·70%	„	219	0	0
Fire Refined 99·50%	„	218	0	0
Copper Sulphate	„	74	0	0
Germanium	grm.		—	
Gold	oz.	12	10	3¾
Indium	„		10	0
Iridium.............	„	20	0	0
Lanthanum..........	grm.		15	0
Lead English.........	ton	71	17	6
Magnesium Ingots....	lb.		2	3
Notched Bar	„		2	9½
Powder Grade 4......	„		6	3
Alloy Ingot, A8 or AZ91	„		2	8
Manganese Metal....	ton	290	0	0
Mercury	flask	74	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	
Palladium	„	5	15	0
Platinum	„	19	10	0
Rhodium	„	40	0	0
Ruthenium	„	15	0	0
Selenium	lb.		nom.	
Silicon 98%..........	ton		nom.	
Silver Spot Bars......	oz.		6	3⅞
Tellurium	lb.		15	0
Tin................	ton	749	0	0
***Zinc**				
Electrolytic..........	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	74	7	6
Dust 95/97%	„	109	0	0
Dust 98/99%........	„	115	0	0
Granulated 99+% ..	„	99	7	6
Granulated 99·99+%	„	113	17	6

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

Aluminium Alloy (Virgin)		£	s.	d.
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10....	„	221	0	0
B.S. 1490 L.M.11....	„	215	0	0
B.S. 1490 L.M.12....	„	223	0	0
B.S. 1490 L.M.13....	„	216	0	0
B.S. 1490 L.M.14....	„	224	0	0
B.S. 1490 L.M.15....	„	210	0	0
B.S. 1490 L.M.16....	„	206	0	0
B.S. 1490 L.M.18....	„	203	0	0
B.S. 1490 L.M.22....	„	210	0	0

		£	s.	d.
†Aluminium Alloys (Secondary)				
B.S. 1490 L.M.1	ton	142	10	0
B.S. 1490 L.M.2	„	152	0	0
B.S. 1490 L.M.4	„	169	0	0
B.S. 1490 L.M.6	„	186	0	0

†Average selling prices for mid October

		£	s.	d.
***Aluminium Bronze**				
BSS 1400 AB.1......	ton	222	0	0
BSS 1400 AB.2......	„		—	
***Brass**				
BSS 1400-B3 65/35 ..	„	144	0	0
BSS 249............	„		—	
BSS 1400-B6 85/15 ..	„	191	0	0
***Gunmetal**				
R.C.H. 3/4% ton	„		—	
(85/5/5/5)	„	178	0	0
(86/7/5/2)	„	188	0	0
(88/10/2/1).........	„	237	0	0
(88/10/2/½).........	„	244	0	0
Manganese Bronze				
BSS 1400 HTB1....	„	182	0	0
BSS 1400 HTB2....	„	199	0	0
BSS 1400 HTB3....	„		—	
Nickel Silver				
Casting Quality 12%	„		nom.	
„ „ 16%	„		nom.	
„ „ 18%	„		nom.	
***Phosphor Bronze**				
B.S. 1400 P.B.1 (A.I.D. released)	„	275	0	0
B.S. 1400 L.P.B.1....	„	201	0	0
Phosphor Copper				
10%	„	238	0	0
15%	„	241	10	0

** Average prices for the last week-end.*

		£	s.	d.
Phosphor Tin				
5%	ton		—	
Silicon Bronze				
BSS 1400-SB1	„		—	
Solder, soft, BSS 219				
Grade C Tinmans ..	„	353	0	0
Grade D Plumbers..	„	285	6	0
Grade M	„	386	9	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated) lb.			—	
Type 9 „	„		—	
Zinc Alloys				
Mazak III	ton	107	2	6
Mazak V	„	111	2	6
Kayem	„	117	2	6
Kayem II	„	123	2	6
Sodium-Zinc........	lb.		2	6½

SEMI-FABRICATED PRODUCTS

Prices of all semi-fabricated products vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium		£	s.	d.
Sheet 10 S.W.G.	lb.		2	8½
Sheet 18 S.W.G.	„		2	10½
Sheet 24 S.W.G.	„		3	1½
Strip 10 S.W.G.	„		2	8½
Strip 18 S.W.G.	„		2	9½
Strip 24 S.W.G.	„		2	11
Circles 22 S.W.G.	„		3	2½
Circles 18 S.W.G.	„		3	1½
Circles 12 S.W.G.	„		3	0½
Plate as rolled	„		2	8
Sections	„		3	2
Wire 10 S.W.G.	„		2	11½
Tubes 1 in. o.d. 16 S.W.G.	„		4	1

Aluminium Alloys		£	s.	d
BS1470. HS10W.	lb.			
Sheet 10 S.W.G.	„		3	1
Sheet 18 S.W.G.	„		3	3½
Sheet 24 S.W.G.	„		3	11
Strip 10 S.W.G.	„		3	1
Strip 18 S.W.G.	„		3	2½
Strip 24 S.W.G.	„		3	10½
BS1477. HP30M.				
Plate as rolled......	„		2	11
BS1470. HC15WP.				
Sheet 10 S.W.G.	„		3	9½
Sheet 18 S.W.G.	„		4	2
Sheet 24 S.W.G.	„		5	0½
Strip 10 S.W.G.	„		3	10½
Strip 18 S.W.G.	„		4	2
Strip 24 S.W.G.	„		4	9½
BS1477. HPC15WP.				
Plate heat treated....	„		3	6½
BS1475. HG10W.				
Wire 10 S.W.G.	„		3	10½
BS1471. HT10WP.				
Tubes 1 in. o.d. 16 S.W.G.	„		5	0½
BS1476. HE10WP.				
Sections	„		3	1½
Beryllium Copper				
Strip	„	1	4	11
Rod................	„	1	1	6
Wire	„	1	4	9
Brass Tubes..........	„		1	9½
Brazed Tubes........	„		—	
Drawn Strip Sections	„		—	
Sheet	ton		—	
Strip	„	244	5	0
Extruded Bar........	lb.		1	11½
Extruded Bar (Pure Metal Basis)	„		—	
Condenser Plate (Yellow Metal)	ton	177	0	0
Condenser Plate (Naval Brass)	„	189	0	0
Wire	lb.		2	7⅛
Copper Tubes	lb.		2	2
Sheet	ton	253	10	0
Strip	„	253	10	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	273	15	0
Cupro Nickel				
Tubes 70/30	lb.		3	5⅝
Lead Pipes (London) ..	ton	112	5	0
Sheets (London)	„	110	0	0
Tellurium Lead	„	£6 extra		
Nickel Silver				
Sheet and Strip 7% ..	lb.		3	6½
Wire 10%	„		4	1½
Phosphor Bronze				
Wire	„		3	11½

Titanium (1,000 lb. lots)			
Billet over 4" dia.-18" dia.	lb.	63/-	64/-
Rod 4" dia.-·250" dia.	„	75/-	112/-
Wire under ·250" dia.-·036" dia.	„	146/-	222/-
Sheet 8' × 2' × ·250"-·010" thick	„	88/-	157/-
Strip ·048"-·003" thick	„	100/-	350/-
Tube (representative gauge)	„		300/-
Extrusions	„		120/-

		£	s.	d.
Zinc Sheets, English destinations	ton	111	0	0
Strip	„		nom.	

Scrap Metal Prices

Merchants' average buying prices delivered, per ton, 29/12/58.

	£
Aluminium	
New Cuttings	142
Old Rolled	120
Segregated Turnings	90
Brass	
Cuttings	138
Rod Ends	132
Heavy Yellow	105
Light	100
Rolled	128
Collected Scrap	103
Turnings	126
Copper	
Wire	190
Firebox, cut up	182
Heavy	178
Light	173
Cuttings	190
Turnings	170
Braziery	145

	£
Gunmetal	
Gear Wheels	170
Admiralty	170
Commercial	148
Turnings	143
Lead	
Scrap	64
Nickel	
Cuttings	—
Anodes	500
Phosphor Bronze	
Scrap	148
Turnings	143
Zinc	
Remelted	54
Cuttings	42
Old Zinc	32

The latest available scrap prices quoted on foreign markets are as follow. (The figures in brackets give the English equivalents in £1 per ton):—

West Germany (D-marks per 100 kilos):		
Used copper wire	(£182.15.0)	210
Heavy copper	(£182.15.0)	210
Light copper	(£152.5.0)	175
Heavy brass	(£104.10.0)	120
Light brass	(£82.12.6)	95
Soft lead scrap	(£58.5.0)	67
Zinc scrap	(£38 5.0)	44
Used aluminium unsorted	(£87.0.0)	100

France (francs per kilo):		
Copper	(£204.10.0)	235
Heavy copper	(£204.10.0)	235
Light brass	(£134.17.6)	155
Zinc castings	(£58.5.0)	67
Lead	(£81.15.0)	94
Tin		—
Aluminium	(£117.10.0)	135

Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£194.7.6)	335
Aluminium copper alloy	(£124.15.0)	215
Lead, soft, first quality	(£83.10.0)	144
Lead, battery plates	(£47.10.0)	82
Copper, first grade	(£200.2.6)	345
Copper, second grade	(£188.10.0)	325
Bronze, first quality machinery	(£197.5.0)	340
Bronze, commercial gunmetal	(£168.5.0)	290
Brass, heavy	(£136.7.6)	235
Brass, light	(£124.15.0)	215
Brass, bar turnings	(£127.12.6)	220
New zinc sheet clippings	(£58.0.0)	100
Old zinc	(£43.10.0)	75

Financial News

E. P. Jenks Ltd.

Net profit available for year to September 30, 1958, £199,214 (£214,361) and dividend of 14 per cent on capital as increased by one-for-one scrip issue (27½ per cent on smaller capital). Group current assets £1,342,747 (£1,350,560), liabilities £413,387 (£489,818). Reserves and surplus £580,440 (£876,409), future tax £168,721 (£161,636).

Alfred Case and Co.

Trading profits for the year are shown at £67,008, and dividend is recommended at 25 per cent, same as for the previous year. Capital commitments at September 30 amounted to £22,500. Year-end group fixed assets amounted to £144,825. Current assets totalled £316,264, against liabilities of £109,351.

Minworth Metals

Group trading profit year to July 31, 1958, £94,332 (£97,422). To tax £53,308 (£56,383), leaving net profit £41,024 (£41,039). Dividend is 25 per cent (same). Forward £64,139 (£48,388), including £1,000 (£2,000) tax provisions no longer required. Group current assets £403,886 (£472,104), including cash £43,990 (£114). Current liabilities £78,202 (£148,530), including overdraft nil (£51,785). Reserves £139,139 (£123,388). Tax reserve £66,334 (£63,223).

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons Limited, Company Registration Agents, Chancery Lane, W.C.2.

Church Bros. Limited (613957), White Hart Yard, Guildford Street, Chertsey, Surrey. Registered October 30, 1958. To carry on business of electro, chromium, silver and nickel platers, etc. Nominal capital, £6,000 in £1 shares. Permanent directors: Mrs. Mabel A. Church and Graham E. Church.

Unity Plating Co. Limited (614019), 243 Manchester Road, Oldham. Registered October 30, 1958. To carry on business of platers in all metals, etc. Nominal capital, £500 in £1 shares. Directors: Frank Wilson and Eileen J. Creed.

W. & D. Electro-Plating Co. Limited (614021), 29 Heathfield Road, W.3. Registered October 30, 1958. Nominal capital, £1,000 in £1 shares. Permanent directors: Charles J. Wilbraham and Thomas Hinde.

Plate Working Machinery Licencees Limited (614215), 415 Oxford Street, W.1. Registered November 3, 1958. To carry on business of manufacturers of and dealers in plate metal working machinery, whether under licence or otherwise; engineers, etc. Nominal capital, £100 in £1 shares. Directors: Stephen Roggendorff and Christian Hausler.

R. and R. Plating Products Limited (614465), 156 Strand, W.C.2. Registered November 6, 1958. Nominal capital, £100 in £1 shares. Directors: David N. Rees and Geoffrey G. Rollings.

Metal Protection Products Limited (614576) Eagle House, Jermyn Street, S.W.1. Registered November 10, 1958. To acquire from Howard T. Stillwell an assignment of an agreement, dated June 10, 1958, with Wynn's Friction Proofing International S.A., relating to the distribution in England, Scotland, Wales and Ireland of the products of the Wynn Oil Company, of California, U.S.A., etc. Nominal capital, £10,000 in £1 shares. Directors: Reginald L. Wells and Howard T. Stillwell.

C. and E. Plating Co (Hockley) Ltd. (614596), 10b Erskine Street, Vauxhall, Birmingham, 7. Registered November 10, 1958. To carry on business of electro, nickel and chromium platers, etc. Nominal capital, £2,500 in £1 shares. Directors: Charles W. Willock and Mrs. E. Willock.

Urmston Metal Spinning Company Limited (614628), 8 Sandsend Road, Davyhulme, Manchester. Registered November 10, 1958. Nominal capital, £100 in £1 shares. Herbert H. Davis signs as director.

Marine and General Brassfounders (B'ham) Limited (614876), 318 Broad Street, Birmingham, 1. Registered November 14, 1958. Nominal capital, £1,000 in £1 shares. Directors: Alan H. Homeshaw and George W. Knott.

Tavak Limited (615244), 25 Newman Street, W.1. Registered November 20, 1958. To carry on business of iron masters, founders and workers, brassfounders, etc. Nominal capital, £15,000 in £1 shares. Directors: Kenneth G. Hartley and Alice V. Thompson.

H. R. Morgan (Metal Pressings) Ltd. (615258), 52-4 Gray's Inn Road, W.C.1. Registered November 20, 1958. Nominal capital, £100 in £1 shares. Directors not named.

Coulby and Lynch Limited (615375), 251 Exchange Road, West Bridgford, Notts. Registered November 21, 1958. To carry on business of general engravers of and workers in metals, metal alloys, etc. Nominal capital, £2,000 in £1 shares (500 cum. pref.). Directors: Harold R. Coulby and Norman Lynch.

Investril Casting and Metallurgical Services Limited (615662), 26-28 Hallam Street, W.1. Registered November 27, 1958. Nominal capital, £1,000 in £1 shares (900 red. cum. pref.). Directors to be appointed by subscribers.

Williamson and Sons Limited (615714), 28 Lovelace Gardens, Surbiton. Registered November 27, 1958. To carry on business of ferrous and non-ferrous metal merchants, etc. Nominal capital, £100 in £1 shares. Permanent directors: Tom R. G. Williamson and Ethel M. Williamson.

Metallurgical Enterprises Ltd. (615739), 52 Alicia Gardens, Kenton, Middlesex. Registered November 28, 1958. To carry on business of dealers in metals, scrap metals, etc. Nominal capital, £1,000 in 900 "A" shares of £1 and 800 "B" and 1,200 "C" shares of 1s. each. Directors: Mrs. Regina Berger and Werner Moos.

THE STOCK EXCHANGE

A Busy Account Ended Very Strong In Tone

ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 30 DECEMBER	+RISE —FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1958 HIGH	1958 LOW	1957 HIGH	1957 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	23/10½	+4½d.	9	10	7 10 9	24/9	17/6	28/3	18/–
400,000	2/–	Anti-Attrition Metal	1/7½		4	8½	4 18 6	1/9	1/3	2/6	1/6
38,305,038	Stk. (£1)	Associated Electrical Industries ...	56/9	—1/-	15	15	5 5 9	58/9	46/6	72/3	47/9
1,590,000	1	Birfield	57/–	+6d.	15	15	5 5 3	62/4½	46/3	70/–	48/9
3,196,667	1	Birmid Industries	71/6	+2/6	17½	17½	4 18 0	77/6	55/3	80/6	55/9
5,630,344	Stk. (£1)	Birmingham Small Arms	37/6	+1/–	11	10	5 17 3	37/6	23/9	33/–	21/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/–		5	5	6 13 3	16/1½	14/7½	16/–	15/–
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	17/1½		6	6	7 0 3	17/4½	16/6	19/–	16/6
500,000	1	Bolton (Thos.) & Sons	26/9		10	12½	7 9 6	28/9	24/–	30/3	28/9
300,000	1	Ditto Pref. 5%	15/–		5	5	6 13 3	16/–	15/–	16/9	14/3
160,000	1	Booth (James) & Co. Cum. Pref. 7%	19/–		7	7	7 3 6	20/4½	19/–	22/3	18/9
9,000,000	Stk. (£1)	British Aluminium Co.	81/3	+8/–	12	12	2 19 0	81/3	36/6	72/–	38/3
1,500,000	Stk. (£1)	Ditto Pref. 6%	19/6		6	6	6 3 0	20/–	18/4½	21/6	18/–
15,000,000	Stk (£1)	British Insulated Callender's Cables	52/3	+3d.	12½	12½	4 15 9	52/3	38/9	55/–	40/–
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	50/–	+4/4½	10	10	4 0 0	47/–	28/3	39/–	29/6
600,000	Stk. (5/–)	Canning (W.) & Co.	24/6		25 + *2½C	25	5 2 0	24/6	19/7½	24/6	19/3
60,484	1/–	Carr (Chas.)	1/3		25	25	20 0 0	2/3	1/4½	3/6	2/1½
150,000	2/–	Case (Alfred) & Co. Ltd.	4/9		25	25	10 5 3	5/3	4/–	4/6	4/–
555,000	1	Clifford (Chas.) Ltd.	22/–		10	10	9 1 9	22/–	16/–	20/6	15/9
45,000	1	Ditto Cum. Pref. 6%	15/3		6	6	7 17 6	16/–	15/–	17/6	16/–
250,000	2/–	Coley Metals	3/–	+3d.	20	25	13 6 9	4/6	2/6	5/7½	3/9
8,730,596	1	Cons. Zinc Corp.†	59/6	+6d.	18¾	22½	6 6 6	59/6	41/–	92/6	49/–
1,136,233	1	Davy & United	86/–	+6d.	20	15	4 13 0	86/–	45/9	60/6	42/6
2,750,000	5/–	Delta Metal	25/–	+3d.	30	*17½	6 0 0	25/–	17/7½	28/6	19/–
4,160,000	Stk. (£1)	Enfield Rolling Mills Ltd.	37/–	+2/–	12½	15B	6 15 3	38/–	22/9	38/6	25/–
750,000	1	Evered & Co.	30/–		15Z	15	6 13 3	30/–	26/–	52/9	42/–
18,000,000	Stk. (£1)	General Electric Co.	39/3		10	12½	5 2 0	40/3	29/6	59/–	38/–
1,500,000	Stk. (10/-)	General Refractories Ltd.	37/3	+1/–	20	17½	5 7 6	39/3	27/3	37/–	26/9
401,240	1	Gibbons (Dudley) Ltd.	66/6		15	15	4 10 3	67/6	61/–	71/–	53/–
750,000	5/–	Glacier Metal Co. Ltd.	6/9	—3d.	11½	11½	8 10 3	8/3	5/–	8/1½	5/10½
1,750,000	5/–	Glynwed Tubes	16/1½	+3d.	20	20	6 4 0	18/1½	12/10½	18/–	12/6
5,421,049	10/–	Goodlass Wall & Lead Industries ...	30/3	+3d.	13‖	18Z	4 6 0	30/3	17/3	37/3	28/9
342,195	1	Greenwood & Batley	57/6		20	17½	6 19 3	57/9	45/–	50/–	46/–
396,000	5/–	Harrison (B'ham) Ord.	15/4½		*15	*15	4 17 6	15/9	11/6	16/9	12/4½
150,000	1	Ditto Cum. Pref. 7%	19/6		7	7	7 3 6	19/9	18/4½	22/3	18/7½
1,075,167	5/–	Heenan Group	7/10½	+1½d.	10	10‡	6 7 0	9/7½	6/9	10/4½	6/9
236,953,260	Stk. (£1)	Imperial Chemical Industries ...	37/6	+1/1½	12Z	10	4 5 3	37/6	27/7½	46/6	36/3
33,708,769	Stk. (£1)	Ditto Cum. Pref. 5%	16/6		5	5	6 1 3	17/1½	16/–	18/6	15/6
14,584,025	**	International Nickel	154¾	—3½	$2.60	$3.75	3 0 3	169	132¾	222	130
430,000	5/–	Jenks (E. P.), Ltd.	9/9		14	27½ϕ	7 3 6	10/–	6/7½	18/10½	15/1½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/–	+4½d.	5	5	6 5 0	16/9	15/–	17/–	14/6
3,987,435	1	Ditto Ord.	45/9	+3d.	10	10	4 7 6	47/–	36/6	58/9	40/–
600,000	10/–	Keith, Blackman	28/9		17½	15	6 1 9	28/9	15/–	21/9	15/–
160,000	4/–	London Aluminium	6/–	+3d.	10	10	6 13 3	6/–	3/–	6/9	3/6
2,400,000	1	London Elec. Wire & Smith's Ord. ...	71/9	+9/3	12½	12½	3 9 9	71/9	39/9	54/6	41/–
400,000	1	Ditto Pref.	24/–	+4½d.	7½	7½	6 5 0	24/3	22/–	25/3	21/9
765,012	1	McKechnie Brothers Ord.	45/–		15	15	6 13 3	45/–	32/–	48/9	37/6
1,530,024	1	Ditto A Ord.	45/–		15	15	6 13 3	45/–	30/–	47/6	36/–
1,108,268	5/–	Manganese Bronze & Brass	13/9	+9d.	20	27½‡	7 5 6	14/1½	8/9	21/10½	7/6
50,628	6/–	Ditto (7½% N.C. Pref.)	6/–		7½	[illegible]	7 10 0	6/3	5/6	6/6	5/–
13,098,855	Stk. (£1)	Metal Box	72/–	+2/7½	11	11	3 1 3	72/–	40/6	59/–	40/3
415,760	Stk. (2/–)	Metal Traders	8/9		50	50	11 8 6	9/–	6/3	8/–	6/3
160,000	1	Mint (The) Birmingham	21/–		10	10	9 10 6	22/9	19/–	25/–	21/6
80,000	5	Ditto Pref. 6%	70/6		6	6	8 10 3	83/6	69/–	90/6	83/6
3,705,670	Stk. (£1)	Morgan Crucible A	43/6		10	10	4 12 0	45/–	34/–	54/–	35/–
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	17/9		5½	5½	6 4 0	18/–	17/–	19/3	16/–
2,200,000	Stk (£1)	Murex	47/3	+1/3	17½	20	7 8 3	58/9	46/–	79/9	57/–
468,000	5/–	Ratcliffs (Great Bridge)	11/–		10	10	4 11 0	11/1½	6/10½	8/–	6/10½
234,960	10/–	Sanderson Bros. & Newbould ...	27/3		20	27½D	7 6 9	27/3	24/6	41/–	24/9
1,365,000	Stk. (5/–)	Serck	18/7½	+6d.	15	17½	4 0 6	18/7½	11/–	18/10½	11/6
6,698,586	Stk. (£1)	Stone-Platt Industries	44/6	+6d.	15	12½	6 14 9	44/6	22/6	33/4½	22/7½
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	15/9		5½	5½	6 19 9	16/3	12/7½	14/–	12/9
14,494,862	Stk. (£1)	Tube Investments Ord.	84/9	+6/3	17½	15	4 2 9	84/9	48/4½	70/9	50/6
41,000,000	Stk. (£1)	Vickers	35/–	+6d.	10	10	5 14 3	36/3	28/9	46/–	29/–
750,000	Stk. (£1)	Ditto Pref. 5%	15/–		5	5	6 13 3	15/9	14/3	18/–	14/–
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	22/6	+6d.	*5	*5	6 18 9A	23/–	21/3	24/9	20/7½
2,200,000	1	Ward (Thos. W.), Ord.	85/–	—3d.	20	15	4 14 0	87/3	70/9	83/–	64/–
2,666,034	Stk. (£1)	Westinghouse Brake	45/6	+1/–	10	18P	4 8 0	45/6	32/6	85/–	29/1½
225,000	2/–	Wolverhampton Die-Casting ...	9/–		30	25	6 13 3	10/1½	7/–	10/1½	7/–
591,000	5/–	Wolverhampton Metal	21/3		27½	27½	6 9 6	22/9	14/9	22/3	14/9
78,465	2/6	Wright, Bindley & Gell	5/3		20	20	9 10 6	5/4½	2/9	3/9	2/7½
124,140	1	Ditto Cum. Pref. 6%	13/–	+3d.	6	6	9 4 6	13/–	11/3	12/6	11/3
150,000	1/–	Zinc Alloy Rust Proof	2/10½	+1½d.	27	40D	9 7 9	3/1½	2/7½	5/–	2/9

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡ and 100% Capitalized issue. • The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. Y Calculated on 11½% dividend. ‖Adjusted to allow for capitalization issue. E for 15 months. P and 100% capitalized issue, also "rights" issue of 2 new shares at 35/- per share for £3 stock held. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. ϕ And 100% capitalized issue. X Calculated on 17½%. C Paid out of Capital Profits.

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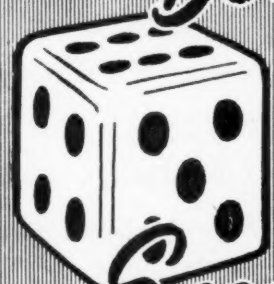

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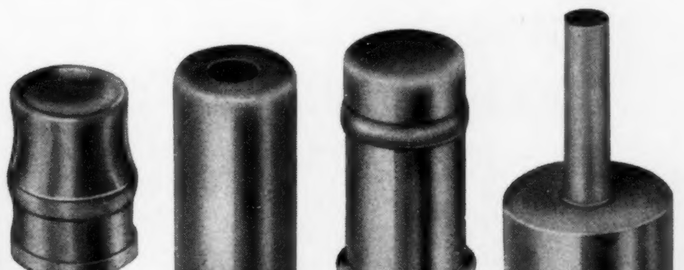

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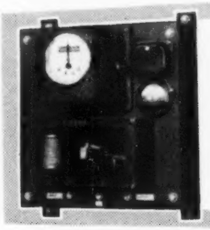

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